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# **CURRENT KNOWLEDGE ATTITUDES AND BELIEFS ON THE ISSUE OF WATER FLUORIDATION:**

**A survey of the current knowledge, attitudes  
and beliefs on water fluoridation of the  
citizens and businesses served by the  
Onehunga Water Treatment Zone.**

A thesis submitted in partial fulfilment  
of requirements for the degree of  
Master of Science (Nutritional Science) at  
Massey University

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# ABSTRACT

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The object of this study was to describe the current knowledge and beliefs on fluoridation of a community served by an unfluoridated water supply prior to the population being consulted on possible implementation of fluoridation by way of a resident's preference survey. Information was also sought on what sort of information the community wanted and the best way of providing it.

The survey was carried out by telephone, using random numbers from the Onehunga Borough water zone provide by Telecom. For the residents, race, gender and age quotas were based on the required sample size fitting the profile population. Businesses were recruited randomly. A semi-structured questionnaire was used and comparisons were made among responses by ethnicity, age and marital status and between the residents and businesses.

The research showed that there were appreciable gaps in the community's knowledge on fluoridation with important differences showing between ethnic groups and the younger and older age group. Younger persons and those who had never been married were less knowledgeable. It also found that the residents were more knowledgeable than businesses on this issue. Pacific people, Asians and others differed significantly from Europeans across most issues. Their lack of knowledge was the greatest. Pamphlets supplied by water-provider organisations or health professionals were the preferred methods of acquiring information on fluoridation. Doctors were preferred over dentists as sources of information, which suggests that dental health professionals need to take a more obvious role in public education on dental health and the role of fluoridation. Despite widespread ignorance concerning water fluoridation,

the majority of those surveyed wanted a voice, via a referendum, in the decision making process. Health authorities were the favoured decision-makers on fluoridation implementation.

This study showed that whilst there is a belief in the benefits of fluoridation within the community there is however a lack of knowledge and understanding especially amongst Pacific people and Asians and others and to a lesser extent amongst Maori and European on the issue of fluoridation. Important differences based on age are also demonstrated. Although there is widespread ignorance, people want a voice in the decision making process. Therefore in developing strategies and information to enable the population to acquire informed opinions on water fluoridation for their community, ethnic and age group differences need to be considered.

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# GLOSSARY

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<b>AI</b>	Adequate intake – the estimated intake shown to maximally reduce caries within a population without causing side effects
<b>UL</b>	Tolerable upper intake level
<b>Approximal surfaces</b>	Touching surfaces between teeth
<b>Caries free</b>	No decayed, missing and filled teeth
<b>DMFT</b>	Decayed, missing and filled teeth due to caries in the permanent dentition
<b>DMFS</b>	Decayed, missing and filled surfaces of teeth due to caries in the permanent dentition; (dentists count five surfaces on each back tooth)
<b>dmft</b>	Decayed, missing and filled surfaces due to caries in the primary dentition
<b>Fluoridation</b>	The addition of certain compounds of fluorine, such as hexafluorosilicic acid, to water to produce a concentration close to 1ppm of fluoride
<b>Non-Fluoridated</b>	Not containing artificially added compounds of fluorine, for example, water containing low natural levels of fluoride ions

<b>Osteoporosis</b>	Thinning of the bones due to loss of bone mineral (there are many factors contributing to this process)
<b>Osteosarcoma</b>	A rare malignant bone tumour
<b>ppm</b>	Parts per million; mg of fluoride in 1 litre of water
<b>Systemic</b>	Entering or acting through the tissues of the body
<b>Topical</b>	Acting on the surface of teeth

# 1. INTRODUCTION

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Water fluoridation, although shown to be safe and beneficial at optimal levels, is still a contentious issue. Communities that have fluoridated water supplies between 0.7 and 1.0 ppm have been shown to have fewer diseased, missing, and filled teeth (DMFT) than non-fluoridated areas. However although the only proven hazard from fluoridation is dental fluorosis, which at mild levels is cosmetic, many people consider fluoride to be toxic and object to its addition to the water supply on health and ethical grounds. This is despite the considerable number of recent reviews, which endorse health, and cost benefits from its use.

Fluoridation of New Zealand water supplies began in 1954 with an estimated 57 percent of the population receiving fluoridated supplies by 1994. One of the Ministry of Health "health outcome" targets was to increase this to 70 percent by the year 2000. The implementation of fluoride to community water supplies not already fluoridated generates controversy between public health officials and outspoken groups who vigorously oppose fluoridation.

At present the Onehunga water supply zone is the only one within the Auckland City which is non- fluoridated as it has a unique supply from the Onehunga springs. (Natural level 0.12mg/l compared with a target of 0.7 to 1.0mg/l). Requests to fluoridate the Onehunga water supply have been refused in the past but a recent application from some residents and interested parties has been forwarded to the Auckland City council by the community board. Local authorities are responsible for making decisions on fluoridation and funding its implementation. In response to the application made in 1999 the Auckland City Council resolved to canvas the wishes of the Onehunga water users by carrying out a general preference survey of residents and businesses in the area. In anticipation of this

survey Auckland Health Care commissioned this study to survey the current knowledge, attitudes and beliefs of citizens and businesses of Onehunga about fluoride and to find out from whom and from where respondents expect to find key sources of knowledge. This information will be used to target the most useful services for the dissemination of knowledge on water fluoridation to permit users to give informed responses to Auckland City's review of public opinion.



## 2. LITERATURE REVIEW

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### 2.1 Introduction

Many areas of the world are deficient in certain minerals resulting in low concentrations of minerals in drinking water, plant crops and farm animal tissues causing certain dietary deficiencies in humans. (Mertz W, 1980). This is true of the mineral fluoride.

Since early this century it has been observed that communities raised in geographical areas with naturally high levels of fluoride in the water supply had a low incidence of dental caries. Following this observation, the artificial fluoridation of reticulated water has been instituted in many countries resulting in the reduction in incidence of dental caries. Opposition to this practice still exists based on ethical and health considerations. Dental caries is a preventable infectious disease of the oral cavity and is a major cause of tooth loss in children and adults.

Fluoridation of New Zealand water supplies began in 1954 and by 1999 it was estimated that 57 percent of the population would be serviced by fluoridated water supplies. The Ministry of Health "health outcome" target for fluoride was to increase the proportion of the population on fluoridated, reticulated water to 70% in the year 2000. Health promotion initiatives targeting the general public and providing information about water fluoridation are seen as urgent.

This literature review looks at fluoride under three broad headings:

#### **The science of fluoride**

- Chemical and biological effects

## **The science of fluoride**

- Chemical and biological effects
- Optimal levels and sources of fluoride
- Bioavailability and intake
- Evidence supporting the safety and efficacy of fluoride as an anticariosis agent.
- Review of alleged detrimental effects.
  
- **Application**
- Dental health statistics
- Ethnic and socioeconomic factors affecting the incidence of decay
- Current practices for improving dental health and range of options
- The effect of diet on incidence of dental caries
- Cost effectiveness of water fluoridation
- Range of options for the delivery of fluoride and their effectiveness.
  
- **Public health issues**
- Reasons for resistance to fluoridation.
- Response to referenda
- How people are influenced and how they make decisions on the subject of fluoridation of their water supply.
- Community issues.

## **2.2 The science of fluoride**

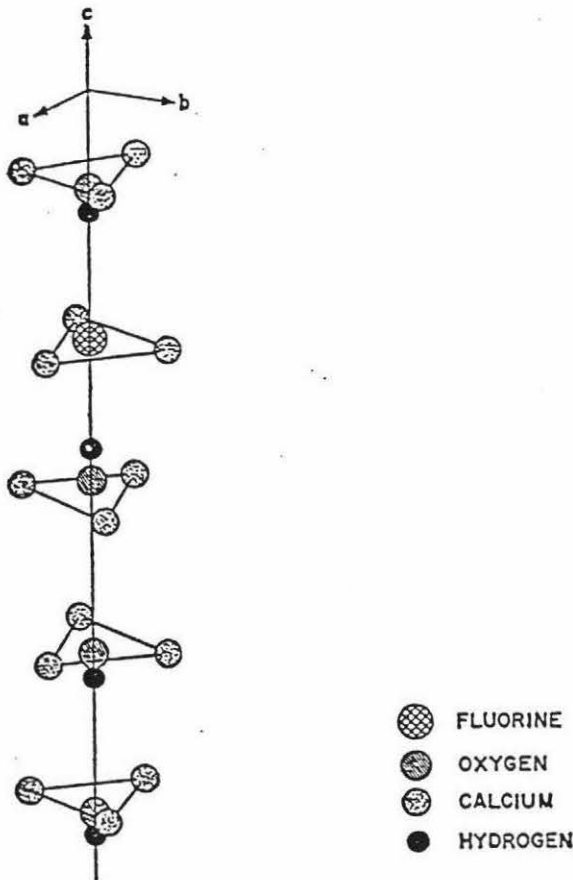
### **2.2.1 Chemical and biological effects**

Fluoride is one of the three halogens essential for normal life, health and reproduction. It is a naturally occurring element that prevents tooth decay systemically when ingested during tooth development and topically when applied to erupted teeth. It is not only important for the hardening of tooth

enamel but contributes to the stability of bone mineral matrix. Rats, fed on a diet low in fluoride exhibit growth retardation, infertility and anaemia all of which can be reversed by adding fluoride to the diet (Eble et al, 1992).

Fluoride is the seventeenth most abundant element in the earth's crust and it is the most electronegative element of the periodic table. It virtually never occurs naturally in its own free gaseous form but is found in its ionic form as fluoride. Fluorides occur in the water, soil, rocks, dust, volcanic gases and the atmosphere. They are present in many plants and virtually all animal tissues, however concentrations vary widely. (Bates et al, 1997)

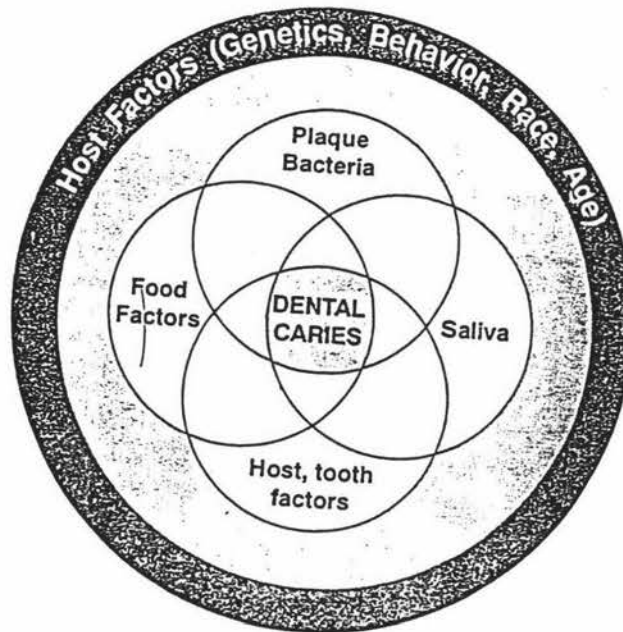
Unlike most nutrients fluoride is absorbed mainly from the stomach, where fluoride combines reversibly with hydrogen to form hydrofluoric acid. Much of the physiological behaviour of fluoride such as the absorption from the stomach, distribution between extra and intracellular fluid and renal clearance is due to diffusion of hydrofluoric acid (Whitford, 1996). Fluoride has a high affinity for calcium and is thus associated with calcified tissue. The main mineral of skeletal tissue is the crystallised form of calcium known as hydroxy apatite (HAP)  $[\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2]$ . Ionic exchange can occur between fluoride ions and hydroxyl ions forming fluorohydroxyapatite (FHA)  $[\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2]$ . This increases the stability of enamel crystals, as fluoridated hydroxyapatite is less soluble in organic acids than hydroxyapatite. It has the ability to not only inhibit but to reverse the initiation and progression of dental caries. It also has the unique ability to stimulate new bone formation (Kleerekoper and Mendlovic, 1993). Figure 2.1 shows the chemical structure of fluoridated enamel. This diagram shows that when the hydrogen atoms of the hydroxyl ions face each other there is insufficient room for them. This void makes the crystal less stable and more soluble. Fluoride ions can enter this void reducing the solubility of the crystal.



**Fig. 2-1** Perspective drawing of the inner part of an apatite crystal (Young and Elliott, 1966 in Fluoride in caries prevention, 1991)

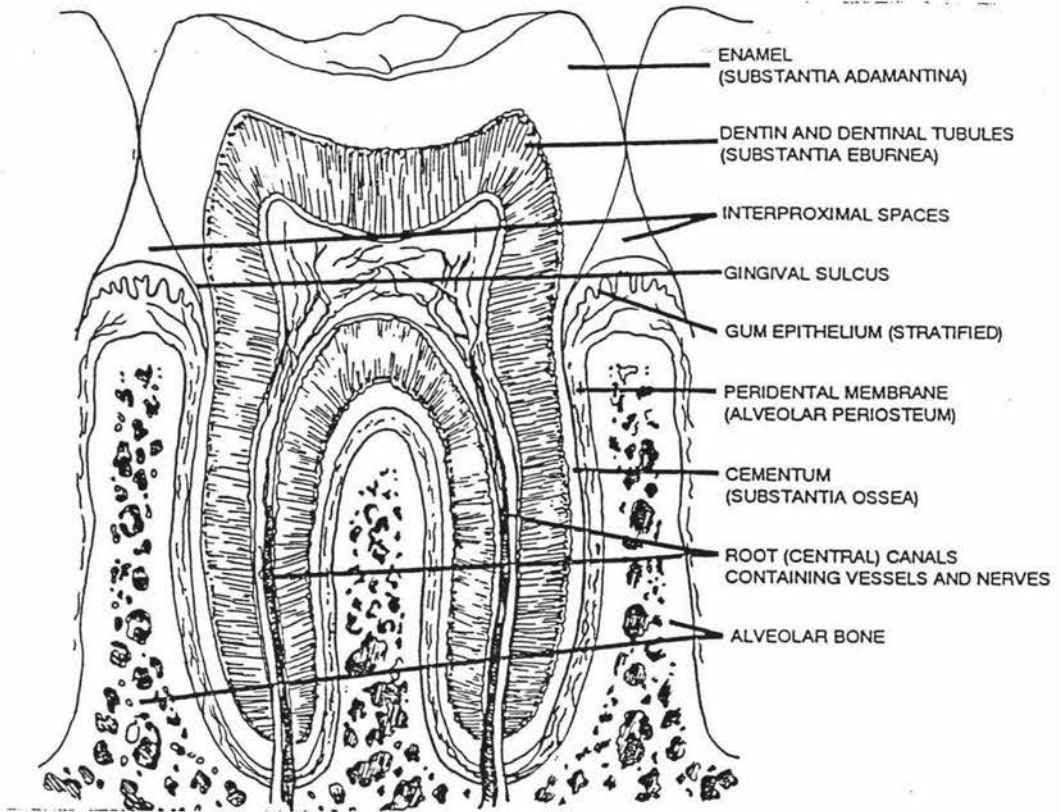
During the pre-eruptive period, the developing enamel and dentine are subject to nutritional imbalances and deficiencies, which can affect enamel development. Research has shown that the ingestion of fluoride during pre-eruptive development of teeth has a cariostatic effect due to the uptake of fluoride by enamel crystallites and the formation of fluorohydroxy apatite (Chow, 1990). Newly-erupted teeth are incompletely mineralised and take up minerals including fluoride from saliva and food shortly after eruption, increasing caries resistance (Sakae and Hirai, 1982). Both pre and post-eruptive exposures to fluoride have a cariostatic effect (Dawes, 1989 ; Horowitz, 1990).

Dental caries is a disease resulting in enamel destruction caused by production of acid by plaque bacteria on teeth when they ferment carbohydrate. There are several major factors that interact in the formation of dental caries. As shown in Figure 2.2, dental caries result from the interaction of four factors in a genetically susceptible mouth. These are plaque bacteria, fermentable foods, fluoride and other minerals, and saliva. These factors over time interact to form dental caries.



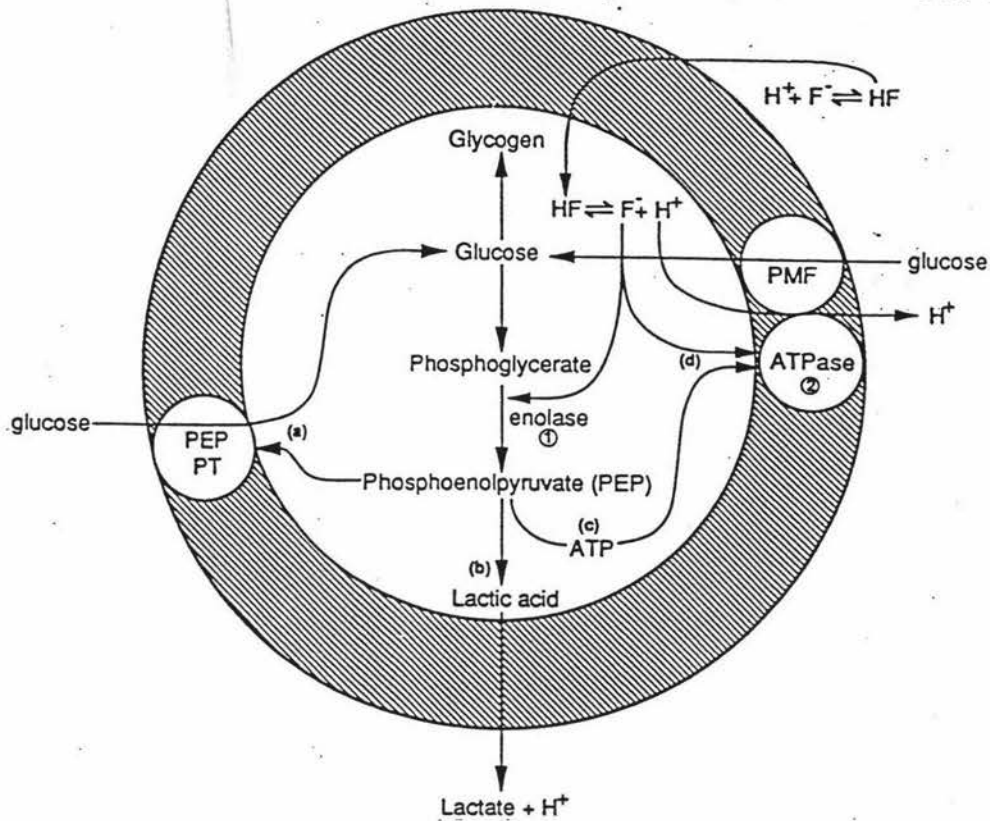
**Fig. 2-2** Major factors that interact in the dental caries process (Shils et al, 1994)

Plaque is a sticky gelatinous mass of gram positive bacteria with extracellular polysaccharides, proteins and lipids. When food is ingested, plaque bacteria metabolise the carbohydrate component to form organic acids (lactic, butyric, acetic, formic and propionic) which causes the plaque pH to drop resulting in enamel dissolution (Birkland and Charlton, 1976). Once through the enamel dental caries can continue into the dentine, eventually damaging the pulp. (See Figure 2.3). It affects large numbers of the population (Hay et al, 1985; PHC 1994b).



**Fig. 2-3** Schematic illustration of a tooth in contact with bone.  
(Shils et al, 1994:p1008)

The cariostatic effect of fluoride on erupted teeth is due to its effect on the metabolism of bacteria in dental plaque. It acts by inhibiting several enzymes, within the plaque, limiting glucose uptake and hence acid production. (Marquis, 1990). For example, the main site of fluoride inhibition in the pathway of acid production is the enzyme enolase which converts phosphoglyceric acid to phosphoenopyruvic acid (PEP) preventing the production of lactic acid and consequent drop in pH (Leverett et al, 1995). (See Figure 2.4)



**Fig 2-4** Simplified figure showing the uptake of glucose by bacteria and the sites of inhibition by fluoride. (Fluoride inhibits the enzyme enolase leading to the reduction in lactic acid production.)

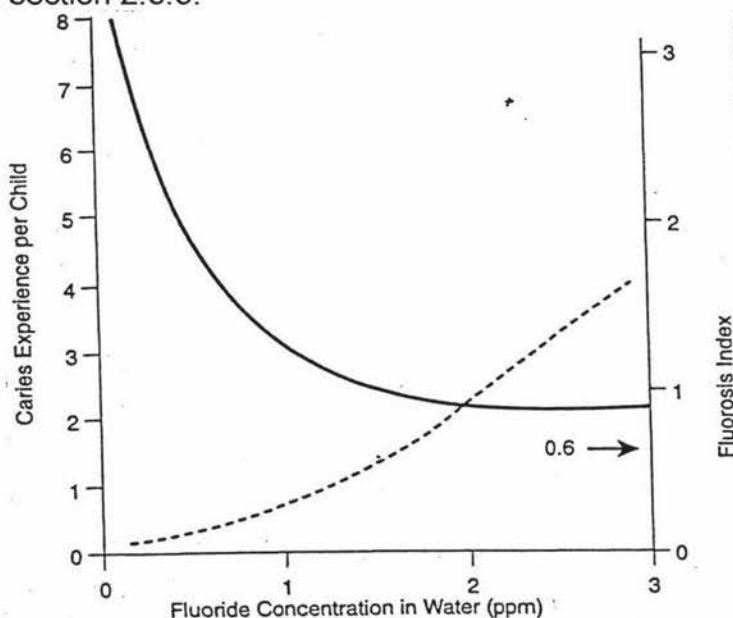
(Fluoride in caries prevention, 1991;p311)

The prevention of a drop in pH of the fluid surrounding teeth reduces the severity of the acidic challenge to the enamel (Hamilton, 1977). The effect is directly related to the fluoride concentration in and the exposure to water, food, and dental products containing fluoride (Margolis and Moreno, 1990). The effects of fluoride on enamel demineralisation and remineralisation of teeth as described by Margolis and Morena, (1990) include the following: reduction in acid solubility of enamel, the promotion of remineralisation of enamel lesions and the inducement of reprecipitation of fluoridated hydroxyapatite within the enamel. This is because fluoride replaces carbonate of the enamel, reducing solubility. After dissolution by acid, enamel provides fluoride ions, which along with those from plaque and saliva favour remineralisation. Fluoride also accumulates in early

lesions at concentrations high enough to reduce solubility. (Shils et al, 1994). These mechanisms require frequent exposure to fluoride throughout life to maintain adequate concentrations of fluoride in dental plaque and enamel. The presence of fluoride in small but elevated concentrations in plaque fluid during the development of lesions not only slows down the rate of demineralisation but at the same time enhances the deposition of fluoridated apatite into the lesion surface resulting in remineralisation (Margolis and Morena, 1990).

### 2.2.2 Optimal levels and sources of fluoride

According to the United States Public Health Service the desirable fluoride concentration for dental caries prevention is approximately 1 part per million (0.7-1.2ppm allowing for climatic temperature variation), with an absolute upper limit for naturally fluoridated water supplies at 4pp (USPHS, 1991). A series of studies in the 1930 and 1940s demonstrated that where fluoride was in water at a level of 1ppm the protective effect was near maximum whilst enamel fluorosis was minimal (Murray et al, 1991). (See Figure 2.5). Other media used for mass fluoride supplementation include fluoridated salt, milk and fruit juices as discussed in section 2.3.3.



**Fig 2.5** Relationships among caries (solid line) and dental fluorosis (dashed line) and fluoride concentration of drinking water.

(Dean, 1942)



In the 1950s the optimal level of fluoride in New Zealand was established at 0.9 to 1.1mg/l but was revised in 1990 to 0.7 to 1.0mg/l because of the increased availability of other sources of fluoride, such as fluoride toothpaste, (Nutrition Task Force, 1991). This is believed to be the most effective and efficient method of preventing dental caries in communities on reticulated water (National Drinking Water Standards Review Expert Working Group, 1995). Fluoridation of New Zealand water is adjusted to 0.7ppm. The maximum acceptable value for fluoride, (MAF) not considered to cause any significant risk to health of the consumer over a lifetime is 1.5mg/l

The fluoride content of rocks in the earth's crust is around 300-700ppm. In unfertilised soils it is usually above 300ppm. New Zealand, by contrast, has relatively low natural fluoride levels in the soil and the water. For example, soil samples taken throughout the country range between 68 and 540 ppm, the mean being 200ppm. The fluoride content of the New Zealand diet is similar to other countries but as it is uncertain how much fluoride is absorbed from the diet it is difficult to assess its contribution (Guha, and Chowdhury, 1992). Shaw and Sweeney, (1980) showed that populations consuming less than 0.3ppm compared with 1ppm showed the largest comparative incidence of dental caries. This has led to the recommendation that in areas where the water fluoride level is low it should be supplemented to 1ppm. This is known as the optimal level of fluoridation. The fluoride level of in seawater is naturally 0.8 to 1.4mg/l thus fluoridated water discharge will not increase the natural fluoride levels.

### **2.2.3 Bioavailability and intake**

#### **Bioavailability**

The bioavailability of fluoride is generally high. For example, sodium fluoride digested with water results in almost complete absorption although it can be influenced by what it is ingested with. When ingested with milk

and other foods, with a high concentration of calcium, absorption can be reduced by up to 30 percent (Ekstrand and Ehrnebo, 1979). This is probably because fluoride has to be released from the bound form (CaF) by digestion before it can be absorbed. A further explanation is that the milk will raise the pH of gastric juice resulting in the formation of a smaller portion of the readily absorbed HF (Spak, et al 1982). The absorption of fluoride from toothpaste, (added as sodium fluoride and monofluorophosphate) is almost 100 percent when swallowed (Ekstrand and Ehrnebo, 1979).

### **Intake**

The average fluoride content in a 70kg body is 2.6 to 4.0 g. Geographically there is large variation in daily intake of fluoride. For example in the Netherlands the total daily intake is between 1.4 and 6.0mg. Parts of India also have very high levels of fluoride in the soil and water (averaging between 1 and 5 mgF/l and in some areas exceeding 21mgF/l). In China, plant foods in particular have very high levels of fluoride (Krishnamachari, 1987), (Murray et al, 1991). Ten independent studies in the U.S. and Canada, between 1958 and 1987 showed that dietary intakes of fluorides by adults ranged from 1.4 to 3.4mg/day in fluoridated areas but between 0.3 and 1.0mg/day where water was non-fluoridated (Dietary Reference Intakes, 1997). Walters et al, 1983 calculated that the average daily fluoride intake from food, as opposed to drinking water was 1.82mg/day. He calculated that beverages accounted for 70 percent of intake.

Most food sources contain 0.2-1.5pg/gF (ppm) with the exception of some beverages such as tea, in which 2 to 3 cups yields 0.4 to 0.8pg/g and infant formulas and some marine fish, in particular oily fish which has 5-15pg/g (Taves, 1983). The fact that numerous epidemiological studies show a negative correlation of the natural fluoride content of drinking water with the percentage of dental decay in the population suggests that drinking water is the main source of fluoride rather than food (Shaw and Sweeney, 1980). See Table 2.1 showing concentration of fluoride in foods prepared using fluoridated water served to adults hospital patients.

**Table 2. 1** Fluoride concentration of foods  
(Taves, 1983)

Food	Fluoride Concentration (mg/liter or kg)	
	Average	Range
Fruits	0.06	0.02-0.08
Meat, fish, poultry	0.22	0.04-0.51
Oils and fats	0.25	0.02-0.44
Dairy products	0.25	0.02-0.82
Leafy vegetables	0.27	0.08-0.70
Sugar and adjunct substances	0.28	0.02-0.78
Root vegetables	0.38	0.27-0.48
Grain and cereal products	0.42	0.08-2.01
Potatoes	0.49	0.21-0.84
Legume vegetables	0.53	0.49-0.57
Nonclassifiable	0.59	0.29-0.87
Beverages	0.76	0.02-2.74

The fluoride intake between fluoridated and non fluoridated communities is becoming more difficult to ascertain because of the halo effect created by the movement of foods and beverages prepared in fluoridated areas, to communities with low water fluoride levels. Between 1950 and 1980 several studies have shown a decline in the prevalence of dental caries in communities that do not have fluoridated water (Kaminsky et al, 1990). This can be attributed not only to improved oral care and fluoridated dentrifices but to the halo effect.

In many countries, including New Zealand, there is a growing preference for bottled beverages over tap water. A recent study showed that the fluoride content of bottled water varied from 0.04ppm to 1.4 ppm depending on water source and filtration method used (Blaney, 1993). Research from the American Dental Association, (1999) shows that the majority of bottled waters on the market do not contain optimal levels of fluoride therefore those consuming bottled water could miss the decay prevention effects of optimally fluoridated water. Water filters, reverse osmosis systems and distillation systems can also remove significant amounts of fluoride from the water supply providing consumers with less than optimal content in their drinking water. Thus the estimation of daily fluoride intake is becoming difficult to ascertain.

For infants, the daily fluoride intake is determined by the type of feeding-whether it be breast-feeding or formula, and whether or not it has been reconstituted with fluoridated water. Human milk is low in fluoride thus breast fed infants receive approximately 0.01 mg/day (Estada et al, 1982). Infants, fed a formula reconstituted with fluoridated water (0.8ppm) would be given a concentration fifty times more than human milk. This level is not considered to be harmful (Department of Health and Social security, 1980), however some mild fluorosis in primary teeth can be seen in infants fed formula reconstituted with fluoridated water but this does not affect secondary teeth. Cows milk has a low fluoride concentration, similar to that of human milk (Larsen et al, 1988). It is to be noted however that New Zealand-made powdered breast milk substitutes use an unfluoridated water source for processing and thus contain negligible amounts of fluoride. Scientific evidence is insufficient to support a recommendation for prenatal fluoride supplementation. As yet there is no evidence to support the view that additional benefit is found when nursing women receive fluoride supplements (Leverett et al, 1997). This is due to the fact that fluoride is poorly transported from plasma to milk and thus concentrations of fluoride in breast milk remain low even if the mothers fluoride intake is high (Spak et al, 1983).

However, Shaw and Sweeney (1980) recommended that in areas of low water fluoride content, water be supplemented to 1ppm or drops or supplements be given orally to children from birth to mid teens. The recommendation of the ADA (1994) is that supplementation not begin until 6 months as intake of human milk at that age does not signify an increased risk of dental caries.

Adequate Intake (AI) is the estimated intake shown to maximally reduce dental caries within a population, without causing side effects such as fluorosis. UL is the tolerable upper intake level. This was established at 0.10mg/kg/day for infants and children up to eight years, when the risk of developing fluorosis of front teeth is usually over. Based on a UL of

0.10mg/kg/day and a reference weight for infants up to 6 months of 7kg, the UL is 0.7mg/day. (See Table 2.2)

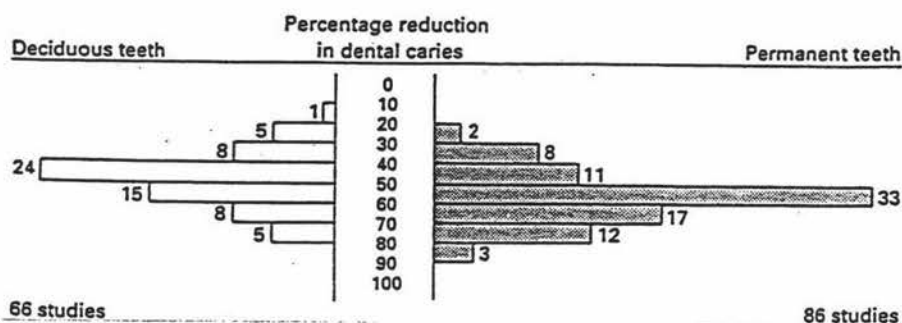
**Table 2. 2** AI and UL of fluoride for infants, children and adults  
(Dietary Reference Intakes, 1997)

Age	AI	UL
0-6mths	0.01mg/d	0.7mg/day
7mths to 12mths	0.5mg/day	0.9mg/day
1 to 3 years	0.7mg/day	1.3mg/day
4 to 8 years	1mg/day	2.2mg/day
9 to 13 years	2mg/day	10mg/day
14 to 18 years	3mg/day	10mg/day
19 years and over	3-4 mg/day	10mg/day
Pregnancy	3mg/day	10mg/day
During lactation	3mg/day	10mg/day

It is estimated that the fluoride intakes of breast fed infants is approximately 0.005 to 0.009 mg/d. Bottle fed infants receive about 0.09 to 0.17mg/day of fluoride (Specker et al, 1997). The average dietary fluoride intakes of adults living in fluoridated areas range from 1.4 to 3.4 mg/day.

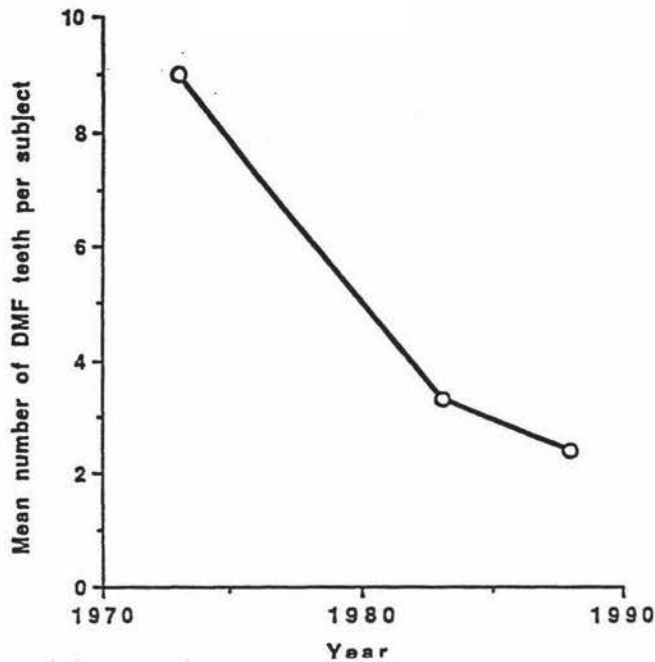
#### **2.2.4 Evidence supporting the safety and efficacy of fluoride as an anti-cariogenic agent**

Between the 1950s and 1980s clinical studies conducted in 20 countries showed that adding fluoride to community water supply resulted in a 40-50 percent caries reduction in deciduous teeth and a 50-60 percent reduction in caries in permanent teeth (Murray et al, 1982). (See figure 2.6 below).



**Fig 2-6** Percentage reductions in dental caries observed in 113 studies into the effectiveness of artificial water fluoridation. (Murray et al, 1991)

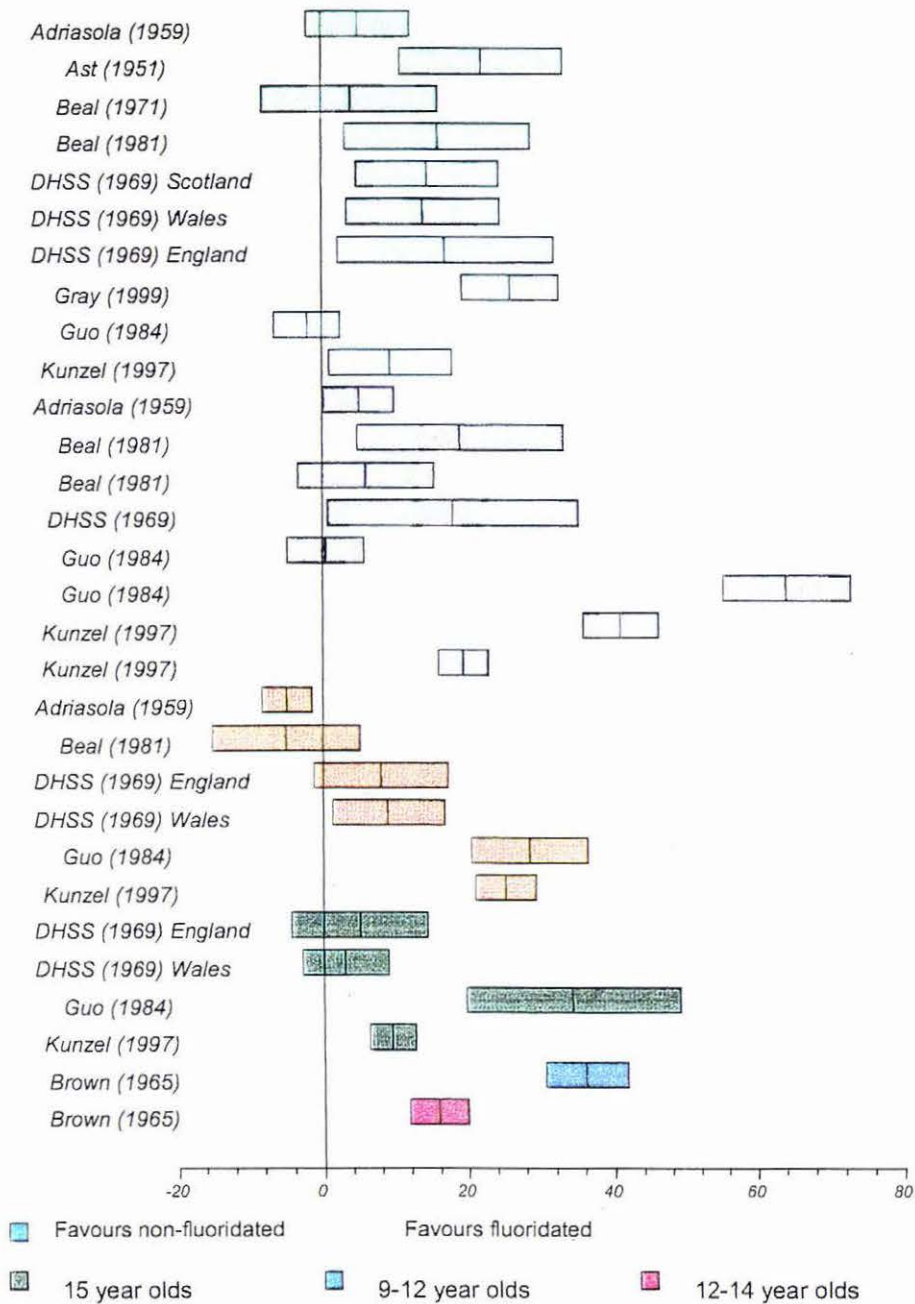
Between 1973 and 1988, the average decrease in total caries in fluoridated areas for 12 year olds in New Zealand was approximately 70 percent (Cutress and Hunter, 1991). (See Fig 2.7) Recent comparisons showed only 25% fewer caries in children from fluoridated areas. This is believed to be due to the “halo” effect produced by consumption of foods processed in fluoridated water, beverages produced using fluoridated water, fluoride toothpaste and the use of topical fluoride increasing exposure of communities in unfluoridated areas. Adults living in communities with optimally fluoridated water also benefit showing a 20 to 30 percent reduction in coronal and root caries. In repeated studies, the advantages and safety of fluoridation have been upheld. (WHO, Community Dental Health, 1996)



**Fig 2-7** Downward trend since 1973, in dental caries experience of permanent teeth of 12 year olds.

(Cutress and Hunter, 1991)

The University of York carried out a recent systematic review, of the fluoridation of drinking water and health (York study, 2000). The aim of this research was to assess the positive and negative effects of population-wide drinking water strategies to prevent caries. Whilst many studies had been carried out, few had been designed to test the effects over time. Of the 26 studies, which met the strict quality requirements, it was shown that fluoride does indeed reduce caries prevalence. (See Figure 2.8)



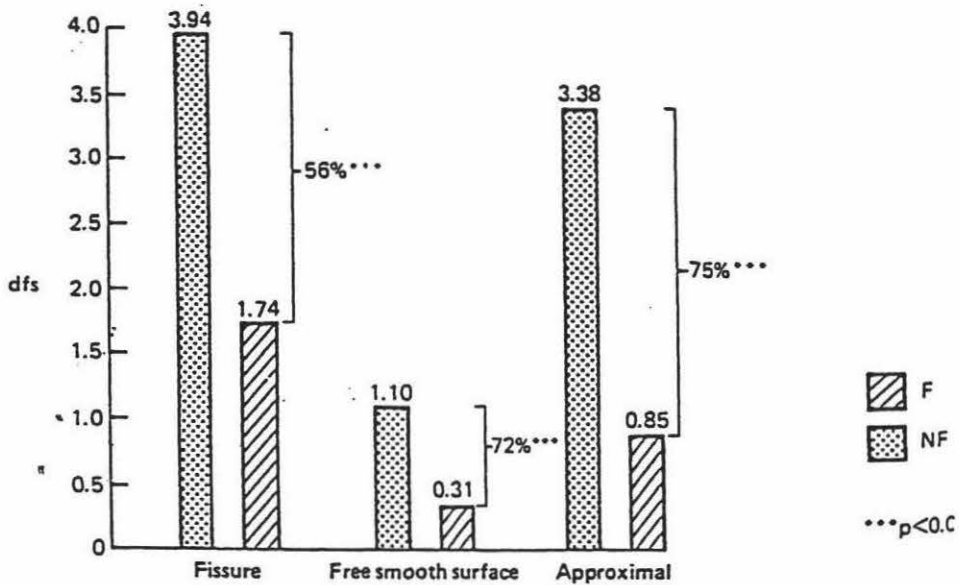
**Fig 2-8** Increase in proportion (%) of caries-free children in fluoridated compared to non-fluoridated areas (mean difference and 95% CI)

(York Study, 2000)

The degree to which fluoride determines caries reduction is not clear from available data but the reduction ranges from 5 percent to 64 percent with a median of 14.6 percent. Approximately 85 percent of reduction is obtained



when fluoride consumption starts between the ages of three and four. In surfaces with high caries susceptibility (pits and fissures) the greatest part of the reduction is derived from pre-eruptive fluoride. Post eruptive fluoride is more significant for low susceptible surfaces (Groenveld, 1990). As shown in Figure 2.9 caries experience (dfs) differs on each surface type with fissures experiencing the highest number of dfs and free smooth surfaces experiencing the least. The greatest percentage reduction between fluoridated and non fluoridated occurring on approximal surfaces.



**Fig 2-9** Effects of fluoridation on the caries experience for each tooth surface type. (Deciduous dentition of five year old children.) (Rugg-Gunn et al, 1977)

Recent research carried out by Gray and Davies-Slowic (2001) comparing changes in dental health between five year olds living in areas fluoridated since 1987 with those living in non fluoridated areas, concluded that water fluoridation was associated with an increase in the percentage of 5 year olds experiencing no decay.

A review of studies (1974-1999) showed that a beneficial effect of water fluoridation is still evident over and above the assumed exposure to non-

water fluoride such as fluoride toothpaste and other topical treatments such as gels and rinses (York study, 2000). Amongst those reviewed, the study by Hardwick (1982) showed a statistically significant difference in caries increment between non- fluoridated and fluoridated groups. The nonfluoridated group had the greatest increment in spite of fluoridated toothpaste being used by both groups. (See Table 2.3)

**Table 2. 3. Caries studies of fluoridation initiation, completed after 1974 (York study, 2000)**

**Table 5.1 Caries studies of fluoridation initiation, completed after 1974**

Author (Year)	Age	Teeth Type	Mean Difference (95% CI)	Year of final survey	Validity Score
<b>% Caries-free</b>					
Guo (1984)	5	Primary	-2.0 (-6.4, 2.4)	1971 - 1984	4.8
	8	Permanent	64.1 (55.4, 72.8)		
	8	Primary	0.4 (-4.8, 5.6)		
	12	Permanent	28.5 (20.5, 36.5)		
	15	Permanent	34.4 (19.7, 49.1)		
Gray (1999)	5	Primary	26.0 (19.4, 32.6)	1988 - 1997	3.5
<b>dmft/DMFT Score</b>					
Guo (1984)	5	Primary	3.6 (2.6, 4.6)	1971 - 1984	4.8
	8	Permanent	1.6 (1.4, 1.8)		
	8	Primary	4.4 (3.9, 4.9)		
	12	Permanent	2.6 (2.2, 3.0)		
	15	Permanent	3.8 (2.7, 4.9)		
<b>Cohort Study: Difference in Increment in DMFS/DMFT score (Control - Fluoridated)</b>					
Hardwick (1982)	12	Permanent	DMFS 2.5 (1.0, 3.9)	1974 - 1978	6.8
	12	Permanent	DMFT 1.1 (0.4, 1.8)		

In a recent systematic review of the safety and efficacy of fluoridating drinking water researchers concluded that evidence of a beneficial reduction in caries should be considered together with increased incidence of dental fluorosis. However there was no clear evidence of other potential adverse effects despite allegation (McDonagh et al, 2000).

### 2.2.5 Review of alleged detrimental effects

Fluoride is one of the trace elements where doses for toxic and beneficial effects are not widely separated. However, acute toxic effects are rare. For humans it is estimated that an intake of 8ppm over 35 years would exhaust storage for skeletal fluoride. Excess in tissues would lead to calcified tendons and ligaments and development of bone spurs due to the stimulation of the parathyroid hormone system (Krishnamachari 1990). This condition is common in parts of India and China where there are

areas of high fluoride concentration. Body fluid and tissue fluoride concentrations are proportional to the long-term level of intake, as there is no homeopathic regulation of fluoride (Guy, 1979). Approximately 99 percent of the body's fluoride is found in calcified tissue. The primary adverse effects associated with prolonged excess fluoride intake are dental and skeletal fluorosis.

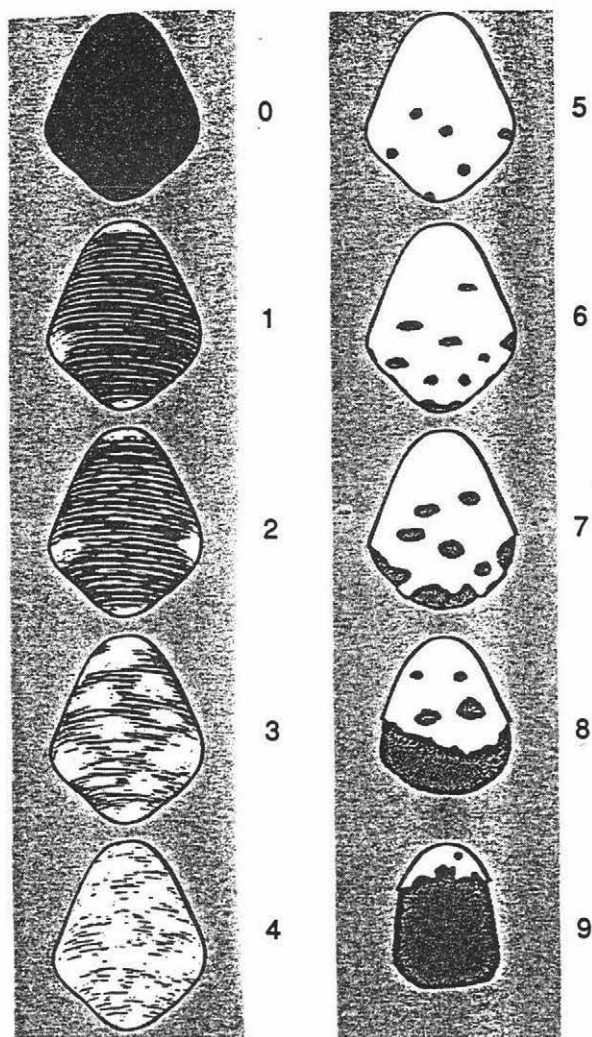
### Dental fluorosis

Dental fluorosis is hyper calcification of tooth enamel or dentine produced by ingestion of excessive amounts of fluoride during the period of teeth development (up to eight years of age). (Fluorosis tends to be greater in permanent teeth than primary). It is characterised by white, opaque flecks and varying shades of brown staining. Severe cases result in pitted tooth enamel. Mottling is caused by ingestion of excess fluoride when teeth are forming in the jaw. Dean, in 1934 developed an index for assessing the presence and severity of mottled enamel. (See Table 2.4) Subsequently other indices for measuring dental fluorosis have been developed although Dean's index has been the most widely used measure of fluorosis.

**Table 2. 4.** Dental fluorosis classification by H.T. Dean, 1942  
(American Dental Association, 1999)

Classification	Criteria Description of Enamel
Normal	Smooth, glossy, pale creamy-white
Questionable	A few white flecks or white spots
Very mild	Small opaque, paper-white areas covering less than 25% of the tooth surface
Mild	Opaque white areas covering less than 50% of the tooth surface.
Moderate	All tooth surfaces affected; marked wear on biting surfaces
Severe	All tooth surfaces affects; discrete or confluent pitting; brown stain pitting; brown stain present.

Dean himself however, recognised the difficulty in differentiating between normal, questionable and very mild fluorosis. In 1978 Thylstrup and Fejerskov developed an index based on changes in single tooth surface. (See Figure 2.10) below



**Fig 2-10** Diagrammatic illustration of the clinical features of dental fluorosis from its mildest form TF1 to its most severe form TF9

(Fluoride in dentistry, 1996)

The critical stage for the development of fluorosis is from birth to five years for incisors and up to eight years for other teeth (Fejerskov et al, 1977). The development of primary tooth fluorosis is mostly a postnatal event except in areas of very high water fluorides. The effect is mainly cosmetic and occurs in areas such as New Zealand if children are heavily exposed to excessive use of fluoride toothpaste or inappropriate consumption of fluoride supplements (Campbell, 2000, Pendrys, 2000, Hargraves et al, 1970). Toothpastes generally contain 1000 or 1450 ppmF. Thus 1 gm of toothpaste contains about 1.0-1.5mgF. For adults and older children, and in small doses for younger children, it is beneficial exerting a systemic (pre-eruptive) effect and a topical (post-eruptive) effect. Exposure to multiple sources of fluoride increases the risk of fluorosis. Mild fluorosis has no effect on teeth function, is considered by some researchers to be attractive and may even render enamel resistant to caries. Enamel fluorosis, unless severe, is regarded as a cosmetic effect rather than a functional adverse effect. (Clark et al, 1993). Among possible risks of water fluoridation, the best established is dental fluorosis. Most overseas and New Zealand research, suggest that as a result of exposure to water fluoridation there is an increase in the levels of very mild and mild dental fluorosis.

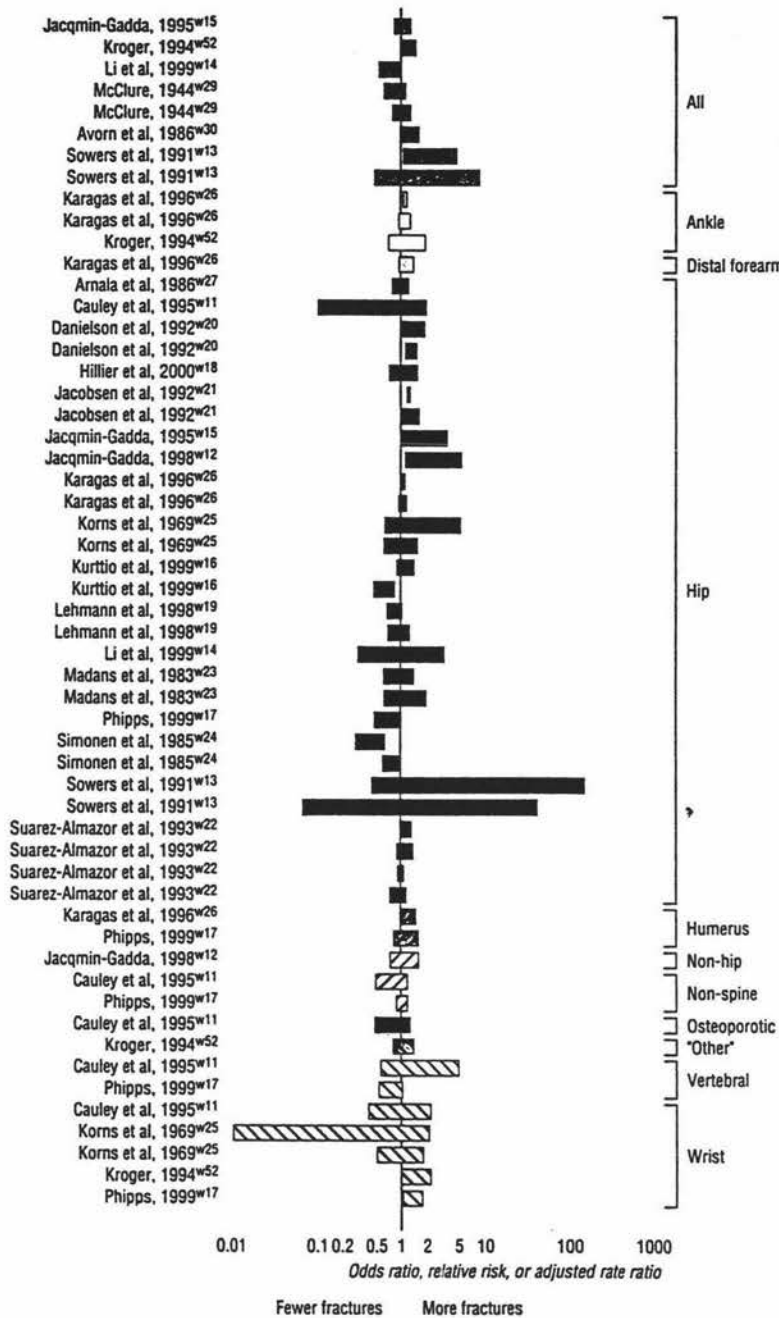
The prevalence of fluorosis at water levels of 1.0ppm was estimated to be 48 percent for "any" sign of fluorosis and 12.5 percent for fluorosis of aesthetic concern. As stated by Riordan (1993), "Fluorosis, at a level that causes cosmetic concern is more likely to be attributed to other forms of fluoride use such as supplements and toothpaste, than to water fluoridation." Rojas Sanchez et al (1999) found that the major component of daily fluoride ingested by young children in non-fluoridated and fluoridated areas came largely from ingested toothpaste. Thus even in nonfluoridated areas care should be taken to ensure young people be given a restricted amount of toothpaste to prevent fluorosis.

It is to be noted that in some areas of the world such as India, China and Africa drinking water contains very high levels of naturally occurring

fluoride and fluorosis can be particularly severe. Fluoride levels of over 10ppm can be common, rising as high as 145ppm. In parts of Tanzania, for example defluoridation of drinking water is of greater public priority than fluoridation (Manji, 1983).

### **Skeletal fluorosis**

Skeletal fluorosis is another adverse effect associated with excessive fluoride intake. Skeletal fluorosis causes a slight increase in bone mass and is characterised by occasional stiffness in joints and some osteosclerosis of the pelvis and vertebrae. Epidemiological research has shown that an intake of 10mg/d for 10 years is required to produce clinical signs of a mild form of skeletal fluorosis (Hodge, 1979). Although it has been suggested that high intake of fluoride leads to hip and other bone fractures, findings are inconclusive as seen in Figure 2.11 which summarises a systematic review of the effects of fluoride on bone fracture



**Fig 2-11** Incidence of bone fracture (estimates of effects and 95% confidence interval)

(McDonagh et al, 2000)

Hip fractures are more closely associated with low body mass and physical inactivity. Research shows that high doses of sodium fluoride increases bone density at axial sites whilst at peripheral sites bone density is

decreased (Riggs et al, 1990). The idea that fluoride might increase the risk of fracture is only seen when intake is substantially higher than optimal water fluoridation levels. There is some conflicting evidence from epidemiological studies. Jacobson et al (1992) suggested a positive association between concentration of fluoride in water and incidence of hip fracture. Others have found no association. For example recent population control studies by Hillier et al (2000) on the relationship between hip fracture and water fluoridation concluded that fluoridation of water at 1ppm was not likely to have any effect on the risk of hip fracture. Results from the University of York Study (2000) showed that there was no clear association between hip fracture and water fluoridation and commented that little high quality research had been done. Of the 18 studies investigated, (30 analyses) 14 found a positive association between water fluoridation and hip fracture (decreased hip fracture with increased water fluoride level). Of these, five were statistically significant. Fourteen found the association negative (increased hip fracture) Of these only four were statistically significant. There were no definite patterns of association for any of the fractures.

The evidence on other fractures is similar. Research by Phipps et al, 2000 showed that exposure to fluoridation was associated with an increase in bone mass at the lumbar spine and proximal femur and a slight decrease in the risk of hip and vertebral fractures. Women with long term exposure to fluoridated water had decreased bone mineral density of the radius. This correlates with the proportion of women with incidents of fracture as seen in Table 2.5. In many countries sodium fluoride has been used in the treatment of osteoporosis.



**Table 2. 5.** Proportion of women with incident bone fracture stratified by exposure to fluoride in drinking water and site of fracture, 1997-99.

(Phipps et al, 2000)

<b>Fracture site</b>	<b>No Exposure</b>	<b>Mixed Exposure</b>	<b>Continuous exposure</b>
Non- vertebral	22.3	24.3	22.6
Spine	5.6	4.3	4.4
Hip	3.6	3.4	2.9
Humerus	2.8	3.0	2.4
Wrist	4.4	4.8	5.8

This table shows that women with continuous fluoride exposure have fewer spine, hip and humerus fractures than do women with no exposure. These findings suggest that if fluoridation reduces the risk of hip fracture it may be an effective method of reducing incidence of fractures caused by osteoporosis.

Evaluation of fluoride therapy for osteoporosis suggests that it not only stimulates osteoblast activity but that it stabilises bone mineral by substitution of F ions for OH ions in bone apatite and increasing bone crystal size. Fluoride supplements (50mg/day) have been used to stimulate bone formation and retard bone mineral losses (Jowsey et al, 1972). However according to Riggs et al (1992) a four-year study of daily oral sodium fluoride therapy failed to show a decrease in fracture rate in spite of increased bone mass.

### **Fluoride and cancer**

Because osteosarcomas may develop in rats exposed to fluoridated water, it was suggested that it might pose a cancer risk to humans (Bucher et al, 1991). An analysis of the cumulative risk of bone cancer in 40 areas studies from 1958 to 1987 showed that cumulative risk was unrelated to water fluoridation and may have resulted in poor coding practices.

However, given public caution when it comes to health safety and the increase in bone cancer in young men it has been suggested by Frenzi and Gaynor, (1992) that further studies should look at the association between fluoride and bone cancer. In the University of York's recently published systematic review of the ten studies considered for the association of osteosarcoma, bone and joint cancer incidence none found a statistically significant association. See Table 2.6

**Table 2. 6.** Association of osteosarcoma, bone and joint cancer incidence and mortality with water fluoride level.  
(York study, 2000)

Author (Year)	Age	Sex	Direction of Association		Cancer	Summary measure	Results	Validity score
			-	+				
Kinlen (1975)	All ages	Both	-		Bone	Ratio of SMR	1.06 (0.6-1.9)	4.0
Mahoney (1991)	<30	Male		+	Bone	Crude RR	0.93#	2.8
	<30	Female		+			0.96#	
	30+	Male		+			0.84#	
	30+	Female	-				1.1#	
Hoover (1976)	All ages	Male	-		Bone	Ratio of SMR	1.2#	3.8
	All ages	Female	No association				1.0#	
Hoover (1991)	Not stated			+	Bone and joint	Mean difference of change in SIRs	0.05	3.3
Gelberg (1995)	<24		-		Osteosarcoma	OR	2.07 (0.5-8.0)	4.3
	<24		-				1.84 (0.8, 4.2)	
Hoover (1991)	Not stated		-		Osteosarcoma	Mean difference of change in SIRs	0.09	3.8
Hrudey (1990)	All ages			+	Osteosarcoma	Crude RR	0.93 (0.6-1.6)	4.0
Mahoney (1991)	<30	Male		+	Osteosarcoma	Crude RR	0.98	2.8
	<30	Female		+			0.78	
	30+	Male		+			0.88	
	30+	Female		+			0.91	
McGuire (1991)	0-40	Both		+	Osteosarcoma	OR	0.33 (0.0, 2.5)	3.5
Moss (1995)	Not stated	Both	No association		Osteosarcoma	OR	1.0 (0.6-1.5)	6.0

Therefore it can be concluded that findings from international reviews that there are no significant health risks associated with water fluoridation at optimal levels and that decay rates are significantly lower in communities with fluoridated water (Wright, 1999).

## 2.3 Application

### 2.3.1 Dental health statistics

With the introduction of water fluoridation in the 1950s successive surveys showed a reduction in prevalence of dental caries. The benefits of fluoridation to the primary teeth of children under the age of eight years are found in Table 2.7 below.

**Table 2. 7.** Studies examining the effects of fluoridation on the deciduous teeth of children.

(Water fluoridation in New Zealand, public health commission 1994; p17)

Review period	No of studies	Caries reduction
1956-1979 (Murray and Rugg-Gunn in Ripa, 1993)	55	Mode = 40-50% Range = 20-80%
1979-1988 (Newbrun, 1987)	9	30-50%
1986-1987 (Brunnelle and Carlos, 1989 in Ripa, 1993)	National survey	39%

The effect of water fluoridation on children aged over 12 years is summarised in Table 2.8. The mean reduction in dental caries for the United States was 26.5 percent. For Britain, Canada, Ireland and New Zealand the mean reduction was 36.1% (Newbrun, 1989).

**Table 2. 8.** Studies examining the effect of fluoridation on the permanent teeth of children.

(Water fluoridation in New Zealand, PHC, 1994).

Review period	No. of studies	No of countries	Caries reduction
1956-1979 ( Murray and Rugg-Gunn, in Ripa, 1993	73	16	Mode = 50-60% Range = 20-90%
1979-1989 ( Newbrun, 1989)*	9	5	Mean = 30% Range = 8-55%

\* Includes two New Zealand studies ( de Liefde and Herbison (1985, 1989)

Studies and reviews by Colquhoun and Diesendorf in the 1980s suggested that there was no benefit from water fluoridation. They felt that improvements in DMFT were associated with improved socioeconomic conditions. and were not associated with water fluoridation (Colquhoun, 1987a; Diesendorf, 1980). These claims were refuted by others (Burt and Beltran, 1988).

Between 1980 and 1984 the average number of missing, filled teeth of Form 2 children fell from 5.1 to 1.33. Since then there has been a rise in decay as shown in Table 2.9.

**Table 2. 9** The number of DMFT of Form 2 pupils in New Zealand

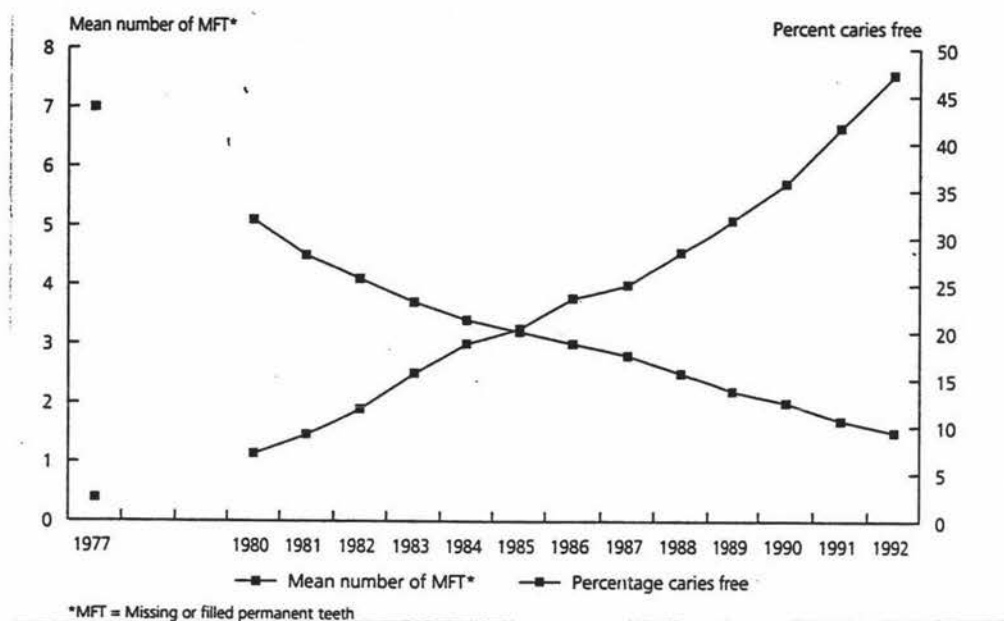
Date	No of *DMF
1980	5.1
1994	1.33
1996	1.53
1997	1.62

\*DMFT = Decayed missing or filled

Data collected from Form 2 children in 1997 showed 1.62 missing and filled teeth overall. This could be due to the fact that we have become complacent about the issue of fluoridation (only 57% of the population having access to fluoridated water supplies), the reduction in school dental service and need to educate the public on oral care and diet. When data was separated out it showed 1.43 missing or filled teeth for fluoridated areas and 1.81 in non-fluoridated areas.

The Department of Health Statistics, 1990 showed that 48 percent of five-year-old children had at least one tooth decayed, missing or filled and by form two, 64 percent of children were affected. However the mean missing and filled score time can be seen in Figure 2.12 with less than 3% caries free in 1977 to almost 50% in 1992. The health outcome target was to reduce this to less than one tooth decayed missing or filled by the year 2000. Statistics from the Auckland central region (1999) show that this has been achieved for New Zealand European children but not for other ethnic groups such as Maori and Pacific people. (See Table 2.12)

Figure 1: The Oral Health of Form Two Children, 1977 and 1980-1992



**Fig. 2-12** Oral health trends for Form 2 children 1977 and 1980 to 1992.

(Fluoride and oral health, PHC, 1995) for all Form 2 children has fallen from 5.1 in 1980 to 1.4 in 1993.

In the Auckland region those missing out on fluoridation are residents of the old Onehunga Borough, the Gulf Islands, Franklin and parts of Rodney County. The following tables show data for children in the central area of Auckland comparing nonfluoridated with fluoridated communities. The region covers from Rodney to Franklin and records whether dental caries is present and the number of decayed, missing or filled teeth (DMFT) see Table 2.10

Table 2.10 (a and b)

School dental data for children in central area  
of Auckland city (1999)

## 5 YEAR OLD CHILDREN

RACE	CENTRAL				REGION			
	% caries free		DMFT		% caries free		DMFT	
	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated
Maori	44.44	53.65	2.52 (54)	1.74 (356)	39.65	47.06	2.78 (401)	2.04 (1545)
Pacific	30.88	44.86	3.94 (68)	2.44 (700)	30.51	40.53	3.68 (118)	2.66 (1927)
European	57.14	83.42	1.73 (98)	0.66 (1514)	66.58	76.06	1.15 (1203)	0.77 (5280)
Other	42.11	60.00	2.84 (19)	1.65 (690)	60.00	55.88	1.83 (140)	1.39 (1836)

## FORM 2 CHILDREN

RACE	CENTRAL				REGION			
	% caries free		DMFT		% caries free		DMFT	
	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated	Non-fluoridated	Fluoridated
Maori	46.88	46.78	2.03 (32)	1.58 (342)	37.8	44.34	1.89 (336)	1.59 (1439)
Pacific	30.99	37.86	2.03 (71)	1.92 (663)	31.63	42.74	2.27 (98)	1.77 (1900)
European	44.25	56.05	1.47 (113)	0.99 (1927)	51.83	55.18	1.14 (1260)	1.03 (6127)
Other	46.88	52.69	1.56 (32)	1.22 (1190)	43.33	47.75	1.58 (150)	1.50 (2687)

These findings demonstrate that there are appreciable differences in the proportion of children, particularly 5 year olds, who are caries free both by race and whether their home water is fluoridated or not. Thus children resident in non-fluoridated water supply areas have poorer dental health than their peers who receive reticulated fluoridated water do.

### 2.3.2 Ethnic and socio-economic factors which effect the incidence of decay.

The recent systematic review by the University of York found that, although there appeared to be some evidence that water fluoridation reduces the inequalities in dental health across social classes for five and twelve year olds, research was insufficient to allow confident statements about the impact on social inequalities. However, dental statistics of New Zealand children indicate that Maori and those from lower socio-economic groups receive the greatest benefit from water fluoridation (PHC, 1994). (See Table 2.11.)

**Table 2. 11** Dental decay prevented in five year old New Zealand Children by socioeconomic group  
(Treasure and Dever, 1992)

Five year old children by socioeconomic group	No of DMFs prevented in 5 year olds
Groups 1 and 2 (least socioeconomic disadvantage)	0.2
Group 3 and 4	2.5
Groups 4 and 6 (Greatest socioeconomic disadvantage)	3.5

Figures from a 1999 study, which compares the percentage of five-year-old children who, are caries free; from a non-fluoridated area (Onehunga) with those from a fluoridated area shows discrepancy not only between



fluoridation areas but also between racial groups. Table 2.12 below shows a high rate of decay amongst Maori and Pacific people.

**Table 2. 12** Percentage of caries free five year olds in fluoridated and non-fluoridated areas, by ethnicity

(From Report to the City Works Committee, Auckland City Council, D Campbell, 2000)

<b>Ethnicity</b>	<b>Non fluoridated</b>	<b>Fluoridated</b>
Maori	44% caries free	54% caries free
Pacific people	31% caries free	45% caries free
Pakeha	57% caries free	83% caries free

Statistics for five year old children show that the risk of dental decay is higher for Pacific people and Maori and lower socioeconomic groups who least utilise dental care services. It is these groups who have been demonstrated to receive the greatest benefit from water fluoridation. Similar findings by Jones and Worthington, (2000) in an English study, showed that although tooth decay was strongly associated with social deprivation, the implementation of water fluoridation had a marked effect on the twelve year olds studied, reducing the socio-economic dental health inequalities. Although fluoride toothpaste use is associated with average caries prevention of 25% after 2-3 years, a recent study in Porirua showed that a significant portion of certain population groups do not use a fluoride toothpaste or even brush their teeth daily. (26 percent Pacific people, 23 percent Maori compared with five percent of European children in Porirua) (Campbell, 2000, personal communication, with Peter Dennison, Public Health Dentist for Wellington, January 1999).

Thus the relatively poor health status of Maori and Pacific people living in New Zealand is mostly due to poorer socioeconomic circumstances. However, as noted by Durie (1994) Maori are not a homogenous group and have diverse realities with respect to health. This is also true for Pacific people.

### **2.3.3 Current practices for improving dental health and range of options for the delivery of fluoride.**

It has been acknowledged that The School Dental Service and The Adolescent Dental Service no longer meet the needs of many children and adolescents, particularly lower socioeconomic group and Maori and Pacific people. In areas where the water is not fluoridated the oral health of children and adolescents is generally noticeably worse. Strategies to address this disparity recommended by The Ministry of Health include:

- Provision of health education programmes, providing advice on
- Oral hygiene
- Nutrition with particular focus on reduction of dietary sugar
- Support and information for parents about breast feeding
- Provision for fluoridation of public water supplies.

#### **Water fluoridation**

The most commonly used effective method of improving dental health is the adjustment of fluoride in drinking water to between 0.7 and 1ppm. The aim of the Ministry of Health was to increase the percentage of the population receiving reticulated fluoridated water from 63 percent to 70 percent by the year 2000. The benefits of water fluoridation is the prevention of between 2.4 and 12 decayed missing or filled teeth per person during their lifetime (PHC, 1994). The Ministry of Health is also to investigate the role of local and central government in the fluoridation of public water supplies. The improvement of oral health was one of the twelve priority population objectives in the draft New Zealand Health Strategy with the proportion receiving water fluoridation one of the current targets (The New Zealand Health Strategy, 2000).

It is to be noted that the addition of fluoride to salt comes second to drinking water as a vehicle in some countries. Fluoridated salt has been on sale in Switzerland since 1955. Salt at 250ppmF is used voluntarily by 70 percent of the population and its effectiveness is considered to approach levels recorded for water fluoridation (Marthaler, 1983).

### **Fluoride supplements**

Although carefully controlled use of fluoride tablets in areas where there is non-fluoridated water can have useful systemic and topical effect, (when chewed) they have limited application as a public health measure. Reasons for this include low continued use of tablets (Brown et al, 1990). Also, children who use them are usually from homes, which promote oral hygiene. When not taken in appropriate dosage fluoride tablets can be a risk factor for dental fluorosis (WHO, 1994). Although topical application of fluoride rinses, gels or varnishes can significantly reduce caries when used consistently, these usually only reach those attending dental health professionals and are therefore expensive (Wei and Yiu, 1993).

### **Fluoride toothpaste**

Ninety five percent of toothpaste sold in New Zealand is fluoridated. Fluoride toothpaste is an effective tool for preventing dental caries providing additional benefit above that of fluoridated water. It combines the mechanical effect of tooth brushing on plaque with the delivery of fluoride to the plaque-tooth surface. The concentration of fluoride in toothpaste is achieved by the addition of fluoride salts such as sodium fluoride (NaF at 0.2%) sodium monofluorophosphate ( $\text{Na}_2\text{PO}_3\text{F}$  at 0.76%) and stannous fluoride ( $\text{SnF}_2$  at 4%).

In non-fluoridated areas it is the main method of preventing dental caries, showing an average caries reduction of approximately 25 percent in children (Murray et al, 1991). Public health recommendations for its use are that teeth should be brushed twice daily with toothpaste containing 1,000ppm of fluoride and that children under the age of five should only use a smear on a small brush and should be discouraged from swallowing it (PHC, 1995).

### 2.3.4 The effect of diet on incidence of dental caries

As stated by Rugg-Gunn (1993), "Dental caries is the most important dental disease and dietary sugars are the most important cause of dental caries." The cost of dental disease is a heavy burden on many countries. Millar, (1979) assessed dental caries to be the greatest nutritional problem in the world. At the time he estimated there to be 2135 million people affected worldwide. Patterns have changed since then with a reduction in dental caries in developed countries and an increase in developing countries due to a move away from traditional foods.

In reviewing evidence relating to dental health, dietary sugars are strongly associated with the prevalence of dental caries as shown in Figure 2.13 which shows a clear association between sugar consumption and diseased, missing and filled teeth (DMFT) of 12 years old children across 47 countries.



**Fig. 2-13** Dental caries experience (DMFT) of 12- year-old children and sugar supply (g/person/day) in 47 countries

(Sreebny, 1982 in Nutrition and Dental Health ed. A.J. Rugg-Gunn: p117)

The amount and frequency of sugar consumption is important and therefore its reduction is a desirable aim in the dietary control of dental caries. The milk sugar, lactose, does not appear to cause dental caries and likewise the intrinsic sugars of fruit and vegetables are not important in dental caries formation. A high proportion of intrinsic non-milk sugars come from confectionery, soft drinks, table sugar, biscuits and cakes. Unfortunately confectionery is designed and marketed for frequent eating. The health recommendations are that consumption of sugar should decrease and the energy deficit be restored with starchy foods such as rice, potatoes, pasta and bread. This is because starch is not transported across cell membranes of plaque organisms. It must be converted to a sugar before it can be used to produce acid (Mormann and Muhlemann, 1981). Although the addition of sugar increases the cariogenicity of cooked starchy food, overall dietary starch is much less a threat to teeth than sugar. Dental health can therefore be improved by a reduction in non- milk extrinsic sugars, increased amounts of fibre rich staple starchy food and fresh fruit and vegetables (Rugg-Gunn, 1993). Dietary components considered protective are milk, cheese and phytate. Reasons given for this are:

### **Milk**

The sugar of milk, lactose, is one of the least cariogenic sugars. Also, the high concentration of calcium and phosphate in milk helps to prevent dissolution of enamel. Due to the differing proportions of these two minerals in bovine and human milk, bovine has a more protective effect than human milk. Milk also slightly reduces the pH of plaque acid, which may also add to its protective effect.

### **Cheese**

Eating cheese after a sugar-containing snack raises the pH of plaque back to a safe level due to the stimulation of the saliva flow. The textural, structure, casein, calcium and phosphate levels all play an important part in its protective qualities. Cheese raises the concentration of calcium in

plaque and the absorption of protein on to the surface of the enamel physically slows the dental caries process.

### **Phytate**

The protective factor of phytate found in unrefined carbohydrate such as wheat bran is due partly to the ability of organic phosphate to absorb readily and firmly to enamel surfaces preventing acid attack and also to the fact that fibrous foods require much chewing thus increasing the saliva flow. (Rugg-Gunn, 1993)

The control of sugar intake is potentially the most effective of all methods of control. The 1999 Ministry of Health Nutrition survey showed that non-alcoholic beverages contributed approximately 10 percent of energy intake of young adults between the ages of 15 and 24 years. Carbohydrate provided 45 percent of energy for males and 47 percent for females. (The 1991 Task Force guidelines were set at 50 percent or more). Sucrose was found to be the predominant sugar consumed by both males and females at 62g/day and 45g/day respectively. It is estimated that the average teenager in United States is getting 15 to 20 teaspoons /day of added sugar from soft drinks alone. Teenagers who tend to have high between-meal intake, such as sweet drinks and snacks have an increased caries rate. Children who derive more calories from processed carbohydrate snack foods and sugar have higher caries rates (Burt et al, 1998). Research has also found that within a few minutes of ingestion, fructose and glucose cause plaque acid to drop and thus appear to be as cariogenic as sucrose. However, when eaten as part of a meal, (for example, fruit salad) their cariogenic potential is lowered due to high water content and presence of citric acid, which stimulates saliva. Xylitol, (a five carbon sugar alcohol) used in Canada and Europe to replace sugar, does not cause a drop in plaque pH because bacteria lack enzymes to ferment it. Frequent use of chewing gum sweetened with Xylitol/ sorbitol mix causes a reduction in plaque acid (Soderling et al, 1989). Baby bottle tooth decay can occur between the ages of one and two years due to exposure of teeth to long periods of sugary liquids.

Research has shown that when sugar was introduced to the Maori diet there was a dramatic increase in caries. Evidence from old skulls show that only 12.5% of early Maori skulls had carious teeth. In modern Maori the prevalence of dental caries in 0-5 year olds was 62.25%. Compared to their ancestors the state of oral health of modern Maori and Pakeha were relatively bad until the mid nineties (Cutress et al, in press). Improvements can be attributed to fluoridated water supplies, fluoride toothpaste and improved dental care.

A change from their traditional diet of fish, shellfish, sweet potato, fern root, nuts berries and water to the successive introduction of meat products, sugar, sweets and dairy products has had a detrimental effect on dental health (Neohiko Inone, 1993). Research on the Maori population living in Rotorua shows that 81 percent have dental caries and 56 percent have gingivitis. Table 2.13 shows that although most people had some decayed, filled and/or missing teeth (82.8%), DMFT was low for those under the age of 15. Although DMFT increased with age most decayed teeth were treated, however this survey shows that the number of missing teeth increased rapidly with increasing adult age. This survey was carried out in 1991

**Table 2.13** Oral Health status of Maori people in Rotorua and Maketu. (Inone, 1993)

Average number of teeth per person.						
Age groups (No. of person)	~ 5 (111)	6-10 (179)	11-15 (118)	16-25 (123)	26-40 (111)	41- (58)
Present teeth	19.5	23.8	27.1	28.9	26.2	14.7
Intact teeth	16.6	20.1	24.3	22.4	14.1	9.6
Carious teeth	2.9	3.8	2.8	6.6	12.1	5.1
Treated teeth	1.8	3.3	2.7	6.0	10.4	4.4
Untreated teeth	1.1	0.5	0.1	0.6	1.8	0.7
Missingteeth	0.0	0.0	0.1	0.5	3.6	13.9

Evidence of the benefits and harms of fluoridation need to be considered along with the ethical, environmental, ecological, costs and legal issues that surround any decision. These and other issues will be reviewed in the following sections.

### **2.3.5 Cost effectiveness of water fluoridation**

The cost of dental disease is a heavy burden on many countries. The net cost of water fluoridation involves the cost of water fluoridation minus the costs from prevented tooth decay. Calculations show it to be very cost effective and generally safe, effective and legally valid. The low cost of water fluoridation is a strong factor in its favour. Although it depends on the size of the community, it is estimated to cost between 16 and 20 cents per person annually. Economically it has advantages and has the effect of reaching all sections of the community and all age groups.

A combination of fluoridated water and the use of fluoride toothpaste is the most rational cost-effective approach to caries prevention at the community level. Detailed studies throughout the world have proven the cost effectiveness of water fluoridation (Doessel, 1979). The estimated annual savings for New Zealand from water fluoridation are \$1.4 to \$14.3 million (based on the prevention of between 58,00 and 267,000 decayed teeth per year with 50 percent of the population on fluoridated water (Water Fluoridation in New Zealand, 1994, Delvin, 1987). Although the cost benefit is greater for large populations this is only one of the factors in influencing the cost effectiveness of water fluoridation. Other factors include cost of fluoridation injection sites, dental treatment costs, age and socioeconomic structure of the community. The differences in benefits for Maori and non-Maori are due largely to age structure differences. Maori have high birth rates therefore there is a greater portion of young people, (the group who benefit the most). However, the topical effect of fluoridation provides protection against caries for all age groups (Featherstone, 1999).



Three types of fluoridation system are used in New Zealand. These are:

- A powder feed system using sodium fluorosilicate or sodium fluoride;
- A slurry system using sodium fluorosilicate or sodium fluoride
- A liquid based system using hydrofluosilicic acid, (most widely used).

Based on the use of hydrofluosilicic acid (a liquid based system) the annual cost for a population of 300,000 is only nine times more than for a population of 1,000. This is due largely to the set up costs. For example the major capital cost is for a continuous readout fluoride monitor which feeds back to constantly adjust the level of fluoride entering the system. Water fluoridation is extremely economic for populations over 1000 with dental cost savings exceeding fluoridation costs. Safety is maintained by ensuring that the storage tank has sufficient containment to hold the entire contents in the case of a sudden accidental release (Wright et al, 1999).

Water fluoridation has well proven efficacy, is extremely cost effective and has low capital investment costs. It is safe and does not require population behavioural changes. It benefits children especially also those with poor health and of low socioeconomic status. Benefits can last a lifetime (Wright et al, 1999).

## **2.4 Public health Issues**

### **2.4.1 Resistance to fluoridation:**

Despite the marked reduction in caries that has resulted from worldwide use of fluorides, anti-fluoride activity is still wide spread. In some areas of the United States active opposition is increasing not only to fluoridated water but also to products such as mouth rinses (Bohannon, 1985). However there is no world wide trend away from fluoridation.

In a review of published literature and reports on fluoride research, it has been found that many articles that raise fears about water fluoridation lack

substance. Much research is *in vitro* and therefore cannot be extrapolated to health effects on the human population. In many cases socio-psychological and political factors determine public attitudes rather than technical and economic (American Dental Association, 1999).

Within New Zealand the most prolific anti fluoride studies have come from Colquhoun. He maintains his view that dental health is better in non fluoridated areas than those with water fluoridation. In one of his most recent works, (1993g) he described water fluoridation as being a total failure. He believed that the differences in caries prevalence were related to socio-economic factors not fluoridation. This is in contrast to other studies such as the Christchurch Child Development study, which found that caries prevalence was influenced by socio-economic status and fluoridation. Although the Christchurch Child development study showed that higher prevalence of dental caries were associated with lower socio-economic status, being in a solo-parent family and being Maori, the taking of fluoride supplements or having a fluoridated water supply was a significant advantage (Treasure and Dever, 1992).

### **Ethical reasons**

Much of the opposition to fluoridation is on ethical grounds. Fluoridation of water supplies represents a loss of personal freedom, an infringement of individual human rights. To justify it, one must be very confident that the benefits outweigh the risks. Despite the fact that there is overwhelming evidence to support the safety and efficacy of water fluoridation at 1ppm, a committed minority can have substantial influence on public opinion. J Frazier, (1985) states that failing to inform the public on the benefits of fluoridation and to ensure its optimum use represents a form of health care negligence.

Although in the traditional Maori view water has a physical and spiritual importance, Maori favour fluoridation overall for its benefit to dental health (PHC, 1994b).

## **Ignorance**

Research shows that the public probably learns about fluoride treatment from the dentist, about fluoride toothpaste from advertising and water fluoridation through the news media, which is often sporadic and confusing. (Frazier, 1985) In New Zealand, health promotion initiatives targeting the general public and providing information are seen as urgent. A recent survey on attitudes to water fluoridation in South Africa showed that only 25 percent had heard of water fluoridation (Chikte and Brand, 1999). Results of a small survey in Australia showed that whilst 97 percent rated regular tooth brushing and 87% rated regular dental visits and 85% rated calcium as important in preventing tooth decay only 50 percent identified water fluoridation as important in the prevention of decay (Roberts - Thomsom and Spencer, 1999). Thus ignorance is a major challenge to oral health promotion through water fluoridation.

## **Fear**

The public has fears about the possible effects on health caused by water fluoridation. The main areas of concern concentrate on cancer and hip fractures. The possibility of cancer risk is likely to arouse the greatest fear. The latest results from the University of York's systematic review show that no clear pattern of association can be seen. However it is believed that the small possible increased risk of osteosarcoma in young men requires further investigation. Fear, founded or unfounded can completely overshadow benefits arising from a reduced risk of tooth decay (Patterson, 1987). Fear of hyperfluoridation has been expressed in New Zealand and overseas (Collins, 1980).

## **Misinformation**

The opponents of fluoridation use misinformation very effectively by repeatedly alleging that fluoride causes cancer, heart disease and other serious problems. They exploit current phobias about health and disease negatively influencing the public about the safety and effectiveness of water fluoridation. They claim that fluoride is toxic, failing to inform the public that toxicity is dose related (Easley, 1995).

## **Legal issues**

At present it is legal for local authorities to add fluoride to community water supplies and although it is highly unlikely, there are several ways in which this situation could change. For example, a citizens' initiated referendum calling for an end to fluoridation that led to a national referendum could lead to a change in legislation. World wide there is great diversity in legal arrangements associated with the issue of water fluoridation (Murray et al, 1991). In the United Kingdom it is up to the water supply company to make the final decision after a 3 month period of consultation with community health councils, the local authorities and the public. (Samuels, 1993). In the United States legal challenges against fluoridation are very common but seldom succeed with the issue of fluoridation being upheld as a legitimate exercise of Government authority. (Ripa, 1993)

### **2.4.2 Response to referenda**

In New Zealand, the Ministry of Health has legal considerations when making decisions as to whether or not to fluoridate the water supply. Councils must have regard to "all relevant consideration": this includes referendum results if a referendum is held. It is however inappropriate to exclude other relevant considerations and how much weight should be attached to the competing considerations is at the discretion of councils. Within New Zealand there have been four recent referenda in local communities on whether water fluoridation should be introduced, continued or discontinued.

In Timaru where the referendum vote was to discontinue fluoridation, it was found that a private "health foods" company was distributing a pamphlet containing misleading and scaremongering information during the period of voting. The most recent referendum in New Zealand was in the Matamata-Piako district in 1996. It was a telephone referendum with a 3% response rate. Of these 70% were against fluoridation. The council, influenced by a small section of the population, decided to cease

fluoridation. Bohannon, (1985) states that referenda on scientific and technical issues such as water fluoridation should be avoided. He believes that health authorities should make decisions on public health issues. In his symposium on the "New Fight for Fluorides" (1985), Bohannon states that in many communities in the United States the first step used by anti-fluoridationalists is to neutralise the politicians by urging a referendum then bombarding the politicians and the public with anti-fluoridation material. Efforts to market fluoridation to the public by way of a referendum fail more often than not due to the fear and doubt which can easily be engendered in an ill-informed public (Frazier, 1985).

How to involve the public in the decision-making process when implementing new water fluoridation schemes is an ongoing issue. In New Zealand local authorities are responsible for making decisions on fluoridation and funding its implementation. Public health services, contracted to improve and protect oral health of children are expected to advocate fluoridated water supplies. Research carried out in the United Kingdom by Lowery et al (2000), found that anti-fluoridation bias within the press had to be considered when designing any information strategy.

### **2.4.3 How people are influenced and how they make decisions on fluoridation issues.**

The main concern people have about fluoridation are the health effects such as hip fractures and cancer (Public Health Commission, 1993b). The idea that fluoridation encroaches on individual freedoms is also an issue of concern.

Although tooth decay is generally perceived as having a fairly minor and temporary impact on the quality of life, the New Zealand survey data found that most people regard dental problems as fairly serious (Hunter et al, 1992). The public does not seem to place a very high value on the benefits associated with water fluoridation.

Research has shown that there is much less public concern over risks in which individuals seem in control than risks where the exposure is voluntary. Debate prior to a referendum often heightens concern in some people. Any suggestion of an association between water fluoridation and disease such as cancer or hip fractures is likely to create significant public concerns. (Patterson, 1987). Unknown risks tend to be perceived as “riskier” and are often a battle ground for debate between a large portion of the scientific community and a small outspoken group of anti-fluoridationalists. This is despite recent systematic reviews which show significant health and cost benefit from its use (Bates, 2000).

A recent survey in South Africa showed that most people do not know what water fluoridation is or what it does though most felt that if it did reduce tooth decay then it should be implemented. (Chitke and Brant, 1999). A qualitative study carried out in England by Lowery et al (2000) demonstrated that the general public wish to be informed of water fluoridation plans but do not see themselves as the appropriate decision makers.

Professional education seems to focus on treatment rather than primary prevention. (Frazier, 1985). Often there are inconsistencies amongst scientific practitioners and the public on the perceived value of the available methods for oral disease prevention. However, O’Neal’s study (1984) comparing the importance of five methods for preventing caries by dentists and the public, showed that both groups emphasised oral hygiene followed by diet and dental care. The public tends to repeat what the practitioners say. Researchers ranked fluoride as number one. Diversity of opinion within professionals is confusing to patients. Studies from Portland Origin and Minnesota show that the public rates the importance of oral hygiene consistently higher than fluorides in the prevention of dental caries. Frazier, (1985) states that although the public perceives the dental and medical profession as the most trustworthy source of information they tend to receive most information from the media when the topic is

controversial and when the news media perceive fluoride as a "newsworthy" controversy.

#### **2.4.4 Community issues**

In New Zealand, local authorities are responsible for making decisions on fluoridation and funding its implementation. Fluoridation of communal water supplies generates controversy with legislators and local body politicians tending to avoid the issue because of the threat of dispute. Within Auckland City, following resolutions of the former Onehunga Borough, the homes and the businesses (approximately 12000 connections) supplied from the Onehunga springs water source receive nonfluoridated water. (Natural level 0.12mg/l). There have been numerous requests from local residents and interested parties for fluoride to be added to the supply, the most recent being in 1999. To assist their decision making in response to this application Auckland City councilors resolved to canvass the wishes of the Onehunga water users by carrying out a survey of residents and businesses using a general preference measure. The question is, what knowledge do the citizens have and where will they obtain information to enable them to make an informed decision on water fluoridation of their area?

### **2.5 Overall conclusions and inferences from the review of the literature**

There is a vast overwhelming amount of literature concerning fluoridation. The main areas covered in this review are as follows:

- Fluoride is found naturally in our soils, water and plants. Levels of fluoride in soils and thus drinking water vary considerably throughout the world.

- Communities raised in geographical areas with naturally high levels of fluoride in the water supply have low incidence of dental caries.
- Dental caries is a preventable disease of the oral cavity and is a major cause of tooth loss in children and adults.
- A vast body of research shows that fluoride added to the water supply at levels of 0.7 to 1.0-ppm results in substantial reduction in caries in primary and permanent teeth, ranging from 5 to 64 percent.
- Ingestion of fluoride during pre-eruptive development of teeth has a cariostatic effect due to the uptake of fluoride by enamel crystallites and the formation of fluorohydroxy apatite crystals, which show resistance to acid attack. Newly erupted teeth are incompletely mineralised and take up fluoride from saliva and food shortly after eruption. Fluoride also inhibits the action of the enzyme endolase in plaque bacteria preventing the production of lactic acid and thus reducing the acid attack on enamel.
- Dental caries is disease resulting in enamel destruction caused by production of acid by plaque bacteria on teeth, when they ferment carbohydrate.
- Although fluoride toothpaste has resulted in the reduction in caries prevalence the combination of fluoridated water and fluoride toothpaste gives the best results. Research has shown that lower socio-economic groups receive the greatest benefit from fluoridated water.
- Acute toxic effects are rare (uptake of 8ppm over 35 years is estimated to exhaust storage for skeletal fluoride). There is no evidence that optimal fluoride intake has harmful health effects.
- Fluorosis of teeth may occur when fluoride levels exceed the optimal level recommended. Mild fluorosis has a cosmetic effect only. The



critical stage for developing fluorosis is from birth to five years for incisors and up to eight years for other teeth.

- The view that fluoride might increase the risk of fracture is only seen when intake is substantially higher than optimal fluoride levels. Although there is conflicting evidence on this issue the bulk of scientific research show either no risk or reduced risk of bone fracture associated with fluoridation at optimal levels.
- Methods for improving dental health concentrate on teeth, micro-organisms and dietary modification. The most commonly used effective method of improving dental health is the adjustment of fluoride in drinking water to between 0.7 and 1.0ppm. Fluoridation of New Zealand water supplies began in 1954.
- Dietary sugars are strongly associated with the prevalence of dental caries. Dietary components considered protective are milk, cheese and phytate.
- New Zealand dental data from form 2 children show that the average number of DMFT reduced from 5.1 in 1980 to 1.53 in 1996 but rose to 1.62 in 1997.
- The risk of dental decay is higher for Pacific people, Maori and the economically disadvantaged, who least utilise dental care services.
- There is a range of options for delivering fluoride. Sources of systemic fluoride include fluoridated water, salt, sugar and milk, fluoride tablets, oral medication and toothpaste (swallowed). Sources of topical fluoride include fluoridated toothpaste, water, mouth rinse, gels and varnish.
- A combination of fluoridated water and the use of fluoridated toothpaste is the most rational cost-effective approach to reducing dental caries. Annual cost savings for New Zealand from fluoridated

water are estimated to be up to \$14.3 million. The annual cost per person for water fluoridation is estimated to be 18c.

- Much opposition to fluoridation is based on ethical beliefs, ignorance, fear and misinformation.
- The public health services contracted to improve and protect the oral health of children are expected to advocate for fluoridated water supplies.
- How to involve the public in the decision-making process when trying to implement new water fluoridation schemes is an ongoing issue. Because of the controversy often generated on the issue of fluoridation local referenda frequently do not support this measure.
- There is an ongoing need for health officials to develop strategies and information to enable the population to acquire informed opinions on water fluoridation.

## 3. METHODOLOGY

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### 3.1 Introduction

Auckland Health Care wished to find out from (people over 18 years) living in Onehunga area who were not on the reticulated water supply, what their current knowledge, attitudes and beliefs were on fluoridation. They were also seeking information on how the public believed decisions on fluoridation should be made, their satisfaction with the decision making process, what sort of information they would like on oral health and where they would prefer to get this information from. Information was also to be sought from the business community on their reasons for using spring water and their attitudes and beliefs on the issue of fluoridation.

This was the brief from which the researcher began the design of the questionnaire following a comprehensive literature search on the subject of fluoridation. The study instrument was a questionnaire utilising closed and open-ended questions. The initial questionnaire was designed as a face to face interview but, Auckland Health Care requested this be done as a Tele-interview, thus modifications were made to the number of questions and the way questions were asked.

### 3.2 Objectives

The objectives of this research were to find out:

- The current knowledge, attitudes and perceptions, of the citizens and businesses of Onehunga, on the issue of fluoridation.

- What sort of information they would like on fluoridation.
- Where they would be most likely to access this information.
- Their satisfaction with the decision making process

### **3.3 Subjects**

#### **3.3.1 Citizens over 18 years**

Opinions were sought from two populations in the Onehunga community, citizens over 18 years and businesses. These will be discussed in sections 4 and 5.

Information from the Statistics NZ 1996 census was used to target geographical boundaries and profile the population. The total population of Onehunga water supply zone of persons 18 years and over was c18723. A sample of 300 citizens was estimated to be sufficient to give a faithful representation of the total population. The demographics taken into consideration were sex, age, ethnicity, marital status and caregiving responsibility. The reasons for this were as follows:

**Gender:** The opinions of both males and females were relevant to this survey. Percentages of each group selected reflected their frequency within the total population.

**Age:** The subjects were grouped into 2-frequency classes: 18-44, and 45 and over. The reasons for this were because the 18-44 group are likely to be principal caregivers for children and therefore responsible for determining whether or not they receive optimal fluoridation either through the purchase of fluoridated products such as toothpaste and fluoride

supplements or through a fluoridated water supply. The 45 and over group represented the rest of the adult population.

The age/gender stratification is listed below.

29% male aged 18-44	90 persons
17% male aged 45 and over	50 persons
31% female aged 18-44	90 persons
23% female aged 45 and over	70 persons
Total	<u>300 persons</u>

**Ethnicity:** The multicultural demography of Onehunga was taken into consideration with subjects representing the population mix in the appropriate proportions. The proportions assigned to the different ethnic groups were:

59% Euro/Pakeha	180 persons
11% NZ Maori	30 persons
19% Pacific People	60 persons
10% Asian	30 persons
Total	<u>300 persons</u>

**Marital status:** Of the total target population 16% had never been married whilst 84% had been or were married. This frequency was to be represented in our sample population as some way of possibly representing those responsible for caregiving to minors. Respondents were then asked more directly whether they were principal caregivers for any children under 12 years. The reason for this being that teeth are susceptible to dental caries soon after they erupt. For deciduous teeth this is between the ages of 2 and 5, and for permanent teeth around the age of 12 years.

### **3.3.2 Businesses**

It was felt that a random sample of 50 businesses in the Onehunga Borough would be sufficient, rather than the 100 originally proposed. Due to time and budget restriction this was a more manageable number as businesses tend to be reluctant to take part in surveys due to time constraints. The random survey of businesses was to see if there were any differences in the views of business compared with the view of citizens. For the business survey no demographic information was required except that the respondent had to be 18 years or over.

The fluoride-sampling frame is found in Appendix A.

## **3.4 Questionnaire development**

After studying the objectives of the research project and following discussion with Auckland Health Care and the research supervisor, the researcher began formatting the first draft of the questionnaires. The questions were designed so as to:

- Introduce the topic of fluoride,
- Find out how much the respondent knew about water fluoridation
- Find out whether they knew if their water supply was fluoridated
- Find out whether they believed it was beneficial or hazardous and reasons for their beliefs.
- Find out where or to whom they would go for information and what sort of information they would like.

A second questionnaire was prepared to be given to a random selection of businesses in the Onehunga Borough, to not only survey their current attitudes and beliefs on fluoride but to find out if the issue of fluoridation was of any importance to their business.

Several factors shaped the form of the questionnaires. As for most surveys the sample size and design and the questionnaire length were influenced by statistical, financial and operational considerations.

It was to be a telephone survey administered by telemarketing firm TMR, 2000 therefore the questions needed to be clear and concise and restricted in number so as to be completed within approximately 10 minutes.

Due to the racial mix it was assumed that for up to 40% of the population English is probably not the first language. The language used therefore needed to be clear, simple and unambiguous.

The personal and the business questionnaire needed to follow each other as closely as possible except for three respondent specific questions.

The first draft was prepared after consultation with Dr. Donald Campbell of Auckland Health Care then submitted for comment. A trial of the questionnaires on several adults resulted in a sharpening of clarity of questions being asked, and a more logical sequencing.

#### **3.4.1 Peer review**

A third draft of questionnaires was emailed to supervisors Patsy Watson, Donald Campbell and to Carol Pound for peer review. Small alterations were made. The questionnaires were then forwarded to Virginia Hope and The Health Funding Authority who gave their approval, but asked for inclusion of one question in the personal questionnaires (No. 14) asking what other areas of oral health respondents would like information about.

### **3.5 Ethics Committee application.**

Following completion of the questionnaires, approval was sought from The Massey University Human Ethics committee. All necessary documentation was completed by the research supervisor and along with questionnaires was submitted for approval. The ethics application is attached as Appendix B. The following points were raised regarding the application. :

We were requested to:

- Provide The Ethics Committee with a copy of the introductory statement to be used by interviewer
- Clarify the relationship of the research student to the telephone research company and to Auckland Health Care
- Obtain verbal consent from the respondent before the telephone interview began to ensure participation in the survey was voluntary.
- Clarify what was to be done to protect the privacy of the participants.

Details of the researcher's response are given in Appendix B

Approval for the amended application was given as a result of this response.

### **3.6 Method of Surveying**

The Health Funding Authority approved funding for the Telemarketing Company TMR 2000, to carry out the survey by telephone, using random numbers from the Onehunga borough provided by Telecom. The survey was conducted in line with the usual consent and ethical procedures telemarketing firms operate under. Resident participants were recruited by random dialling of the phone numbers falling within the geographical area. Race, gender and age quotas were based on the required sample size fitting the profile population. (See 3.3) Interviews continued until all quotas



of the sampling frame were filled. (See Appendix A). Businesses were recruited randomly from telephone numbers supplied by the Telephone Company, Telecom.

Responses to the questionnaires were collected as hard copy, and at completion of the survey handed to the research student. At the end of the survey the market research company destroyed the unique identifier, phone number and code number master list, thereby maintaining confidentiality of the respondent. Thus no respondent could be identified once the survey was completed.

### **3.6.1 Pilot survey**

Prior to the commencement of the survey the researcher briefed the telemarketing research co-ordinator on the objectives of the survey, and nature of the questionnaires. The researcher then carried out a pilot survey of 12 respondents using randomly selected telephone numbers from the Auckland area, which were provided to the Research Company by Telecom. This was to ensure that the questions were well understood, were able to be carried out within the 10 minute time frame and provided the information required. As a result of this, one question was removed, as it appeared to some respondents that we were asking the same question twice, and alterations were made to the wording of a few questions to clarify the meaning.

### **3.6.2 Bias**

For the purpose this survey, it was felt that sampling by use of random telephone numbers was sufficient to get a representative sample of views of the population. However, telephone surveys have several opportunities for bias. The sampling in this survey was not completely random, being based on ethnicity, gender and age group quotas with allocations being determined from the 1996 census. Onehunga is an area of population

mobility so the proportions used may not have characterised the year 2000 inhabitants. The researchers were aware that 13-15% of households with telephones have unlisted or confidential numbers, and not all households have a telephone, thus the views of these two groups will not be represented. There may also be differences in either the understanding of, or the certainty with which different ethnic groups respond to questions. Although the interviewers were all adequately briefed, skilled, market researchers, they may not have been typical of the residents in terms of age, gender or ethnicity so could have introduced bias. The surveyed population had fewer males and more females than the profile population but on adjusting the responses to the study population's gender distribution, misrepresentation was not found. Respondents were not asked whether or not they had their own teeth. This could introduce bias, particularly in response from the 45 plus age group.

### **3.7 Coding**

The majority of the questions required a one in three response and were allocated the following codes:

Yes	1
No	2
Don't know	9

Coding for demographic questions and all others are found on the questionnaires in Appendix D

### **3.8 Methods of Analysis**

Discrete variables were entered into an Excel spreadsheet using Windows 98. Data was analysed in Excel 1997 and the Minitab standard statistical package version 12. Standard statistical procedures were used in the

analysis. Open-ended questions were recorded, grouped and summarised. The personal questionnaires were analysed separately from the business questionnaires.

# 4 RESULTS OF PERSONAL QUESTIONNAIRE

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## 4.1 Introduction

A random sample of citizens of the Onehunga Borough were surveyed to find out their current knowledge, attitudes and beliefs on the issue of fluoridation. The questionnaires used in this research are found in Appendix B. The answers to the questions asked have been grouped according to the issues covered. The first tabulated results presented give an overall percentage response to the questions. Chi square analysis was applied to see if there was any significant difference in response by age, gender, ethnicity and marital status. As gender was not a significant factor in response given, it is not included in the tables. Results to open-ended questions were summarised and grouped in likeness of response rather than order of frequency.

Results of the business questionnaire are presented in Section 5 and conclude with a comparison of personal and business responses on related issues.

## 4.2 Description of the sample

The sample population consisted of 282 citizens, 18 years and over, representative of a household from the Onehunga Borough water zone. As shown in Table 4.2a, the demographics of the actual and the desired population differed (due to the difficulty in recruiting married Asian and

Pacific people). After an extended period of recruiting the sample was accepted as satisfactory due to time and budget restraints.

The population surveyed had seven percent fewer males and seven percent more females than the profile population, also seven percent more European/Pakeha and seven percent fewer Asians. The "Other" category consisted of Indian, South African, Lebanese and Russian people. The sample population tended to be young (18-44), married and female, however only 30 percent described themselves as principal care givers. The main ethnic groups represented were European/Pakeha, Maori and Pacific people. The response rate for residents was 40 percent. ( i.e.430 residents said "no" to taking part in the survey.)

Demographics of the sample population are shown in Table 4.2a

### **Demographics**

#### **Population of Onehunga water zone:**

Around 18,723 persons aged 18 years and over

**Table 4.2a** Sample population

**Sample for personal questionnaire:**

A random sample of 282 citizens of the Onehunga Borough water zone reflecting the population profile.

	Actual sample: n=282	Sample sought n=300
<u>Age</u>		
18-44	60%	60%
45+	40%	40%
 <u>Sex:</u>		
Male	39%	46%
Female	61%	54%
 <u>Race:</u>		
Euro/Pakeha	68%	59%
NZ Maori	11%	11%
Pacific people	13%	19%
Asian	3%	10%
Other	5%	
 <u>Marital Status:</u>		
Never married	18%	16%
Ever married	82%	84%
 <u>Principal care giver:</u>		
Yes	37%	
No	62%	
Don't know	4%	

### 4.3 Knowledge of Dental Health

The overall responses to Questions one and thirteen are given as percentages in Table 4.3a below. In Question one, respondents were asked if they used fluoride toothpaste. In Question 13 respondents were given five categories and asked to select which was the best way to prevent dental decay. These results show that the majority of the population say *yes* to using fluoride toothpaste (65 percent) whilst 15 percent say *they do not* and 19 percent *do not know*. Oral hygiene was considered the best way to prevent dental decay (64 percent).

Table 4.3b shows the response to Question one by ethnicity, age and marital status using Chi-square analysis. There was a significant difference in ethnic response to this question. Thirty percent of both Maori and Pacific people and 33 percent of Asians plus Others stated that they *didn't know* if they used fluoride toothpaste compared with 14 percent of Europeans. There was a highly significant difference in responses between the two age groups with 71 percent of the 18-44 year olds saying they did use fluoride toothpaste compared with 56 percent of the 45 plus age group. There was no significant difference in response by marital status.

Table 4.3c shows the Chi square analysis of the response to Question 13 by ethnicity. It is to be noted that the Chi square is probably invalid as there are 15 cells with expected counts of less than five, however twice as many Pacific people as expected mentioned *dental visits* as the best way to prevent dental decay, (19 percent) compared with both Europeans and Maoris. The majority of all ethnic groups considered *oral hygiene* to be the best way to prevent dental decay. This was followed by *dental visits*. No Maori mentioned *fluoride* whilst no Pacific people mentioned *diet*.

Table 4.3d shows the analysis of the response to Question 13 by age and marital status. (Note: There were four cells with expected counts less than five). There was no significant difference between response from the two age groups and only a slightly significant difference in response by marital

status. Five percent of ever married stating *fluoride* to be the best way to prevent dental decay whereas this was not mentioned by any of the never married group.

Table 4.3e shows the collated responses to *other* ways of preventing dental decay. *Dental education* was the most frequently mentioned *other* way of preventing dental decay.

**Table 4.3a** Response to Questions 1 and 13

**Question 1 Do you use fluoride toothpaste?**

	<b>Number</b>	<b>Percentage</b>
Yes	184	65%
No	43	15%
Don't know	52	19%
No response	<u>3</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Question13 What do you consider the best way to stop dental decay?**

	<b>Number</b>	<b>Percentage</b>
Oral hygiene	180	64%
Dental visits	29	10%
Diet	23	8%
Fluorides	11	4%
Other	17	6%
No response	<u>22</u>	8%
	<b><u>282</u></b>	<b>100%</b>



**Table 4.3b** Analysis of response to Question 1 by ethnicity, age and marital status

	Euro	Maori	Pacific	Asian + O*	*18-44	*45+	Never M*	Ever M*
<b>Do you use fluoride toothpaste?</b>	Yes 69%	63%	53%	54%	71%	56%	72%	64%
	No 17%	7%	17%	13%	8%	27%	14%	15%
	Dk 14%	30%	30%	33%	21%	17%	14%	21%
<b>P value</b>	(P=0.045)				(P=0.000)		(P=0.434) NS	

\*O = Other

\*M = Married

\*18-44 and \*45+ = age in years

**Table 4.3c** Analysis of response to Question 13, (What is considered the best way to prevent dental decay?) by ethnicity

	Euro	Maori	Pacific	Asians + Others
<b>n =</b>	192	30	36	24
Oral hygiene	66%	63%	56%	64%
Dental visits	9%	10%	19%	10%
Diet	9%	7%	-	8%
Fluorides	4%	-	8%	4%
Other	5%	3%	11%	6%
No response	7%	17%	6%	8%

n = Number of subjects

**Table 4.3d** Analysis of response to Question 13 by age and marital status

	18-44	45+	Never married	Ever married
<b>n=</b>	170	112	51	231
Oral Hygiene	61%	69%	74%	61%
Dental visits	12%	7%	6%	11%
Diet	8%	9%	6%	9%
Fluorides	4%	5%	0%	5%
Other	6%	5%	6%	6%
No response	9%	5%	8%	8%

(P=0.402)

Note: 4 cells with expected counts less than 5

**Table 4.3e** Respondents suggestions to “other” ways of preventing dental decay

Education on dental hygiene	7
Dental education for children	3
Healthy lifestyle/exercise	3
Instruction from parents and teachers	2
Good tooth paste	2
Bring back dental nurses in schools	1
Affordable dental care	1
Don't know	4

#### **4.4 Regional Fluoride Issues**

The overall response to Questions two, three and four are given as percentages in Table 4.4a. The majority of respondents said that they knew the reason for fluoridation (78 percent). Response to question three, which asked if their water supply was fluoridated, was evenly divided with 26 percent saying *yes*, 27 percent saying *no* whilst 46 percent *did not know* whether it was fluoridated or not. When asked whether they would be in favour of fluoridation 48 percent said *yes*, whilst 23 percent said *no* and 22 percent said that they *didn't know*.

Table 4.4b gives the summary of Chi square analysis of responses to Questions two, three and four by ethnicity. Analysis by age and marital status of questions two three and four are given in Table 4.4c. Europeans were much more likely to know the reason for fluoridation than other ethnic groups. Only 10 percent of Europeans said they did not know the reason for fluoridation compared with 30 percent of Maori, 50 percent Asian plus Others and 61 percent Pacific people. This difference is very highly significant. (P=0.000)

When asked if their water supply was fluoridated, 92 percent of Asians plus Others and 78 percent Pacific people said they *did not know* whilst only 37 percent of Europeans said they *didn't know*. Maori and European were better informed than Pacific people and Asian plus Others with 32 percent and 33 percent saying that water was not fluoridated. (As water is not fluoridated in the Onehunga area it is important to note how few people are aware of this fact.) This is a very highly significant result. (P=0.000). Response to Question four, by ethnicity shows that Europeans were more likely to be in favour of fluoridation than the other ethnic groups (55 percent). A high percentage of other ethnic groups said they *did not know*. For example, Pacific people (56 percent), Asian plus Others (50 percent) and Maori (43 percent) compared with 22 percent of Europeans. This is a highly significant result (P=0.000).

Table 4.4c, response to Question two, showed that whilst older respondents were more likely to understand the reason for fluoridation, only 12 percent of those over 45 said they *did not know* the reason for fluoridation compared with 29 percent of those under 45. This difference is highly significant. (P=0.001) Those who had ever been married were much more likely to say that they knew the reason for fluoridation (82 percent) than those who had never been married (59 percent). This is a very highly significant difference (P=0.000).

There was a significant difference in response by the two age groups to Question three where respondents were asked if the water supply to their home was fluoridated. More of the younger age group (54 percent) *did not know* compared with 36 percent of the 45 plus group. Thirty five percent of the 45 plus age group said that the water was *not fluoridated* compared with 22 percent of the 18-44 year olds who said that it was. There was no significant difference in response by marital status.

Whilst there was little difference between the two age groups in response to favouring fluoridation (Question 4), the 45 plus age group was more likely *not to be in favour* of fluoridation (26 percent) compared with the

younger group at 16 percent. Respondents who were ever married were more likely *to be in favour* of fluoridation (50 percent) than those never married (39 percent). Those never married were almost twice as likely to *not know* the reason for fluoridation than those who were ever married. This is a very significant result (P=0.008).

#### **Open ended Question.**

Respondents who said yes that they knew the reasons for fluoridation (Question two) gave their reasons in Question 2b which are presented in Table 4.4d. Approximately 60 percent of people believe that it promotes strong healthy teeth, 17 percent say it reduces dental decay whilst 10 percent say it keeps water clean and kills microbes. Others mentioned bones and gums and one person said it was to compensate for a deficiency in New Zealand soil and water.

**Table 4.4a** Overall percentage response to Question 2,3 and 4

#### **Question 2 Most areas in Auckland have fluoridated water. Do you know the reason for this?**

	<b>Number</b>	<b>Percentage</b>
Yes	220	78%
No	<u>62</u>	22%
	<b><u>282</u></b>	<b>100%</b>

#### **Question 3 Is the water supply to your home fluoridated?**

	<b>Number</b>	<b>Percentage</b>
Yes	73	25%
No	77	27%
Don't know	130	46%
No response	<u>2</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Question 4 Would you be in favour of fluoridation of the water in your area?**

	<b>Number</b>	<b>Percentage</b>
Yes	136	48%
No	58	21%
Don't know	84	30%
No response	<u>4</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Table 4.4b** Analysis of response to Questions 2,3 and 4 by ethnicity

		Euro	Maori	Pacific	Asian + O*
<b>Q2. Do you know the reasons for fluoridation?</b>	Yes	90%	70%	39%	50%
	No	10%	30%	61%	50%
(P=0.000)					
<b>Q3. Is your water supply fluoridated?</b>	Yes	31%	27%	11%	4%
	No	32%	33%	11%	4%
	Dk*	37%	40%	78%	92%
(P=0.000)					
<b>Q4. Are you in favour of fluoridation?</b>	Yes	55%	34%	33%	38%
	No	23%	23%	11%	12%
	Dk	22%	43%	56%	50%
(P=0.001)					

\*Dk =Don't know      \*O = Others

**Table 4.4c** Summary of analysis of Questions 2, 3 and 4 by age and marital status

		18-44	45+	Never married	Ever married
<b>Q2. Do you know the reasons for fluoridation?</b>	Yes	71%	88%	59%	82%
	No	29%	12%	41%	18%
		(P=0.001)		(P=0.000)	
<b>Q3. Is your water supply fluoridated?</b>	Yes	24%	29%	23%	26%
	No	22%	35%	18%	30%
	Dk*	54%	36%	59%	44%
		(P=0.008)		(P=0.124)	
			*NS		
<b>Q4. Are you in favour of fluoridation?</b>	Yes	49%	47%	39%	50%
	No	16%	28%	12%	23%
	Dk*	35%	25%	49%	27%
		(P=0.032)		(P=0.008)	

\*Dk = Don't know      \*NS = Not significant

**Table 4.4d** Open-ended response to Question 2b

**Question 2b Most of Auckland has fluoridated water; do you know the reasons for this?**

Yes            78%

No             22%

**The following reasons were given for yes:**

	<b>Total</b>
To protect teeth/ good for teeth/improves teeth	75
To promote healthy teeth	29
Makes teeth stronger /strengthen enamel	34
Teeth and bones	5
Strengthen bones	1
Calcium for your teeth	1

Teeth and gums	2
Improve dental care/dental health	2
Reduce dental decay/prevent dental decay/stop tooth cavities	42
Children's teeth	13
Reduce dental decay for children	2
Preserving teeth	1
Dental hygiene	1
Keeping good health/good for health	6
To kill microbes / bacteria	7
Cleans water/ purifies water/ sterilisation	17
Counteracts wrong elements in water	1
Mineral supplement	1
Compensate for deficiency in NZ soil and water	1
Council decision	1
Local Governments desire to improve dental hygiene	1
To put the price up	1
Rots your teeth	1
	<b><u>245</u></b>

(NB ordered by association rather than by frequency)

#### **4.5 Health Benefits and Hazards**

Question five asked if respondents believed there were any *health benefits* from adding fluoride to water whilst question six asked if there were any *health hazards* from adding fluoride to water. The overall responses to Questions five and six are given in Table 4.5a. Sixty four percent of respondents believed there were *benefits* whilst 24 percent believe there were *hazards*. Twenty four percent did not know whether there were any benefits whilst 55 percent *did not know* whether there were any hazards.

Table 4.5b shows response to Questions five and six by ethnicity using Chi-square analysis. There was a very highly significant difference in ethnic response to Question five (*benefits* of fluoride). More Europeans than expected said there were *benefits* (73 percent) with fewer than

expected *not knowing* (16 percent). A very highly significant percentage of Pacific people and Asians plus Others *did not know* of the health benefits of fluoridation. (P=0.000). A much higher percentage of Maori (37 percent) and European (28 percent) said that there were *hazards* associated with fluoridation than Pacific people (five and a half percent) and Asians plus Others (four percent). A high percentage of Pacific people and Asians plus Others *did not know* (80.5 percent and 83 percent respectively). This is a significant result.

Table 4.5c shows analysis of Questions five and six by age and marital status. A significantly higher percentage of the 45 plus age group (75 percent) believed there were *benefits* from fluoridation than the 18-44 year olds (57 percent), where as a significantly higher portion of this group said they *did not know*. Sixty eight percent of those who had ever married were aware of health benefits of fluoridation compared with 47 percent of those who had never married. A high percentage of those never married said they *did not know* (47 percent). This is a very highly significant result (P=0.000).

There was a significant difference between the way the two age groups answered Question six. The 18-44 year olds *did not know* whether there were any *hazards* (63 percent) compared with 46 percent of the 45 plus age group who were more likely to express an opinion with more believing *there were hazards* than not. (29 percent compared with 25 percent). Respondents who were ever married were more likely to believe that there *were hazards* from fluoridation (25 percent) than those never married (16 percent). A higher percentage of those never married said they *did not know*, than those ever married.

### **Open ended questions**

Respondents who said they believed there were health *benefits* to fluoridation were asked to state their reasons. (Question 5b) These reasons are presented in Table 4.5d. Of the 182 responses made, 50 (approximately 29 percent) felt that fluoride kept teeth healthy. Eighteen



percent of responses stated that fluoride prevented cavities whilst many responses (25 percent) involved strengthening and protection of teeth with special mention being made of children's teeth. Several responses suggested that fluorides kept water pure, clean and decontaminated.

Respondents who said that there were health *hazards* associated with fluoridation stated their reasons, which were presented in Table 4.5e. Of the 74 responses made 14 (approximately 19 percent) stated that although they believed fluoride was hazardous they couldn't remember the detail. Twenty eight percent felt that it was dangerous in excess and toxic for the body, commenting on the lack of wisdom in putting things into the water system without our consent. Several respondents felt that it affected general health causing such things as headaches, liver damage, toxic build up and cancer. Mention was made of it affecting the taste and smell of water and of being detrimental to bones as you aged. Six responses (eight percent) concerned the mottling and discolouration of teeth. Three people said it rotted teeth.

**Table 4.5a** Percentage of overall response to benefits and hazards (Questions 5 and 6)

**Question 5** Do you think there are any health benefits from adding fluoride to the water in your area?

	<b>Number</b>	<b>Percentage</b>
Yes	181	64%
No	28	10%
Don't know	70	25%
No response	<u>3</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Question 6 Do you think there are any health hazards from adding fluoride to drinking water?**

	<b>Number</b>	<b>Percentage</b>
Yes	67	24%
No	56	20%
Don't know	156	55%
No response	<u>3</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Table 4.5b** Analysis of response to Questions 5 and 6 by ethnicity

		Euro	Maori	Pacific	Asian + Others
<b>Q5. Are there any health <u>benefits</u> from water fluoridation?</b>	Yes	73%	63%	33%	42%
	No	11%	7%	9%	8%
	Dk*	16%	30%	58%	50%
(P=0.000)					
<b>Q6. Are there any health <u>hazards</u> from water fluoridation?</b>	Yes	28%	37%	5%	4%
	No	22%	17%	14%	13%
	Dk*	50%	46%	81%	83%
(P=0.001)					

\*Dk = Don't know

**Table 4.5c** Analysis of response to Questions 5 and 6 by age and marital status

		18-44	45+	Never married	Ever married
<b>Q5. Are there any health <u>benefits</u> from water fluoridation?</b>	Yes	57%	75%	47%	68%
	No	9%	11%	6%	11%
	Dk*	34%	14%	47%	21%
		(P=0.001)		(P=0.001)	
<b>Q6. Are there any health <u>hazards</u> from water fluoridation?</b>	Yes	21%	29%	16%	25%
	No	16%	25%	19%	20%
	Dk*	63%	46%	65%	55%
		(P=0.023)		(P=0.290) NS	

Dk =Don't know

**Table 4.5d** Open-ended response to Question 5b

**Question 5b Do you think there are any health benefits from adding fluoride to the water supply in your area?**

Yes	64%
No	10%
Don't know	25%
No response	1%

**If "yes" what are the reasons?**

	<b>Total</b>
Strengthens teeth/ strengthens enamel / keeps teeth strong	21
Keeps teeth healthy /healthier teeth/ improves/ benefits teeth	52
Good for teeth and gums	1
Good for teeth/ better for teeth and bones	18
Supposedly helps kids teeth/protects children's teeth/ for children's teeth	25
Supposedly good for teeth, haven't seen this for my family though	1
Protects teeth	13
Improves health	4

Improved long term dental care	1
Fluoride builds healthy teeth.-The best way to get it is through water	1
Helps prevent cavities/ stops (reduces) tooth decay/prevents decay	30
Necessary	1
Keeps water pure/clean/ water decontamination/ kills germs	10
Benefits those not using fluoride	1
Might prevent cavities but the benefits are highly exaggerated	1
Not sure what the benefits are	<u>2</u>
	<u>182</u>

**Table 4.5e** Open-ended response to Question 6b

**Question 6b Do you think there are any health hazards from adding fluoride to drinking water?**

Yes	24%
No	20%
Don't know	55%
<b>No Response</b>	<b>1%</b>

<b>If "yes" what are the reasons?</b>	<b>Total</b>
Dangerous if consumed in excess	6
Make bones deteriorate as you get older/ detrimental to bones	4
Lose immunity	1
Cancer causing/ risk of cancer linked to fluoride	3
Teeth mottling from excessive fluoride/ fluorosis	3
Teeth discolouration	3
Health problems like cariosis	1
More chemicals to water-could be harmful/ not everybody can cope	5
Chemicals for the body/like toxin/ fluoride poisoning/ toxic	10
Affects general health /headaches	2
Heard of bad side effects	3
Liver damage	1
Bad taste/ affects taste of water	7
Putting things into system without our consent, not wise	3
Aware of hazards-but would probably be negligible	1

Can't remember/ not sure what /can't remember details	14
Bad smell	1
Chemicals toxic, should go back to using rain water	1
Rots your teeth /too much rots teeth	3
Destroys natural elements in the water	1
I don't believe in it	<u>1</u>
	<u>74</u>

#### 4.6 Expected Sources of Information on Fluoridation

Respondents were given a list of 13 possible sources of information they could access if required to make a decision on fluoridation plus a category described as other. (Question 7). They were not restricted in the number of categories they could choose, thus a total of 462 responses were made. The percentage response to each category is given in Table 4.6a. Eighteen percent of all responses selected the *Council*, 17 percent selected the *Water Supply Authority* with the *doctor*, the *dentist* and the category *Other* all receiving 13 percent of the vote.

The *Other* responses are collated in Table 4.6b. Fifty one percent of those who chose this category said they *didn't know* where they would go to for information. Mention was made of public bodies such as Health Department, Dental Association, Water care and Health centres. Further mention was made of scientific experts such as biochemists, research scientist, government scientist, nutrition teacher at University and local figures such as MP and landlord. Some people were not interested especially in pro-fluoride information.

The percentage of the total number of responses for each category by age and ethnicity are given in Table 4.6c. The 18-44 age group selected the *Council* (19 percent) followed by the *Water Supply Authority* (18 percent), the *Doctor* (15 percent) and the *Internet* at 7 percent. The 45 age group also preferred the *Council* (17 percent), the *Water Supply Authority* (16

percent) the *dentist* at 15 percent, the *Doctor* at 11 percent followed by the *Medical Officer of Health* at 7 percent. The main responses given by the four ethnic groups were as follows: Europeans sought information from the *Council* (18 percent), the *Water Supply Authority* (17 percent) the *Dentist* (14 percent) and the *Doctor* (12 percent). Maori sought information from the *Dentist* (20 percent) and the *Doctor* (20 percent) followed by the *Water Supply Authority* (16 percent) and the *Council* at 12 percent. The Pacific people sought their information from the *Water supply Authority* (28 percent), followed by the *Council* (21 percent), the *Doctor* (17 percent) and the *Dentist* and *Library* both at 6 percent. Asians plus Others sought information from the *Council* (22 percent) followed by the *Doctor*, *Water supply Authority* and *Medical Officer of Health* (16 percent) and the *Dentist* at three percent.

### **Open – ended Questions**

Respondents were then asked (in question eight) if they wanted to know more about fluoridation, what sort of information would they like. Their responses are presented in Table 4.6d. Of the 305 responses given approximately 50 percent required information on pros and cons, benefits and hazards and the risks and the side effects of fluoridation. They also wanted to know how effective it was and if it really worked. Six and a half percent wanted information on safe dosage and the effects of long term consumption. Respondents wanted general information on what it was all about and what it does. A large number of respondents (12 percent) said that they didn't want any information, as they weren't interested. Three said that their minds were made up – they were not interested as they were against it and they wanted no further information. A few comments were made expressing concern about the effect of fluoride on the brain, on allergies and on the whole population. Nine respondents wanted the latest research information and one wanted to know the costs involved.

Respondents were then asked (question 8b) where they would ideally to get their information from. Their responses are presented in Table 4.6e. More than twice as many people preferred getting information from a

*Doctor* than a *Dentist* ( 27percent as compared with 11 percent). Over 50 percent of respondents said they would prefer to get their information from a *pamphlet* whilst many (approximately 23 percent) people preferred getting their information *in person* and some said the *phone*. A considerable number (10 percent) wanted information via an 0800 number. *Rates notices, pamphlets and pamphlets from the council* were all popular methods of getting information.

**Table 4.6a** Percentage response to categories provided in Question7

**Question 7** Currently, where would you go or whom would you speak to if you had to decide whether or not your water supply was to be fluoridated?

Friends	9	2.0%
Family	7	1.5%
Dentist	60	13.0%
Chemist	7	1.5%
Doctor	61	13.0%
Medical officer of health	25	6.0%
Water Supply Authority	81	17.5%
Council	84	18.0%
Media	7	1.5%
Health shop	6	1.0%
Medical centre	9	2.0%
Library	21	4.5%
Internet	24	5.0%
Other	<u>61</u>	13.0%
	<u>462</u>	



**Table 4.6b** The “Other” response to Question 7

**Question 7** Currently, where would you go or whom would you speak to if you had to decide whether or not your water supply was to be fluoridated?

	<b>Total</b>
Don't know	31
Department of health/ health authority	4
Dental association	2
Phil Goff	1
Local MP	1
Research / Government scientist	3
Someone in health centre/ pharmacy	2
CAB	1
Landlord	1
Watercare	3
ESR	1
People for and against/ basic facts	2
Nutrition teacher at University	1
Anyone except those who want to fluoridate water	1
Don't need to / I'm a dental nurse	2
Not interested	4
Biochemist	1
	<b><u>61</u></b>

**Table 4.6c** Percentage of total response to Question 7 by age and ethnicity

**Question 7** Where or to whom would you go for information on fluoridation?

	N =	18-44	45+	Euro	Maori	Pacific	Asian + O*
Friends	9	2%	2%	3%	-	-	-
Family	7	1%	2%	2%	-	-	-
Dentist	60	12%	15%	14%	20%	6%	3%
Chemist	7	1%	2%	2%	-	-	-
Doctor	61	15%	11%	12%	20%	17%	16%
Medical Officer Health	25	4%	7%	5%	7%	2%	13%
Water Supply Authority	81	18%	16%	17%	15%	28%	16%
The Council	84	19%	17%	18%	12%	21%	22%
The Media	7	1%	2%	2%	-	-	3%
Health Shop	6	1%	2%	1%	2%	-	3%
Medical Centre	9	1%	3%	2%	-	2%	6%
Library	21	5%	4%	5%	-	6%	3%
Internet	24	7%	2%	5%	2%	4%	6%
Other	61	12%	15%	12%	22%	13%	9%

**Table 4.6d** Collation of responses to open-ended Question 8**Question 8** If you wanted to know more about fluoridation, what sort of information would you like?

	<b>Total</b>
Pros and cons / benefits and drawbacks / safety and hazards	64
Whether it really works / how effective on the teeth	16
All health advantages / benefits	36
Side effects / hazards/ dangers / risks	29
What level of fluoridation is safe?	1
General information / what it is about	16
Studies into the health effects of long term fluoride consumption	9
Do benefits outweigh the negatives?	1
Studies on health effects / proof	3
Problems it would create in your body	1
What are the benefits apart from helping to prevent tooth decay?	1
Safety/safe quantity	17
Why it is done / why do I need it?	5
What does it mean / What does it do / What is it all about	19
Side effects from overdosing	1
Other ways of getting fluoride / alternatives	4
Dosage	4
May not get the correct amount of fluoride in the water	2
Statistics; a reliable source	1
Effects on whole population	2
Comparison of areas with and areas without fluoride	1
Facts/relevant facts	5
Research / latest medical information	9
How does it improve water?	1
Is anyone allergic to it?	1
Haven't thought about it / don't know / not interested	37
<i>All above</i> (meaning list of prompts)	23
Do we have fluoride?	1
Problems from not having it	1
Have already received information from water care services	1
Nothing as I'm well informed	2

Keep chemicals out of water except chlorine/keep chemicals out of water	2
Where water comes from	1
Against it/not interested in information/mind made up	4
People get enough from toothpaste	1
Long term effects on the brain	1
Why are people querying it when it stops tooth decay?	1
Costs	1

/ = Different response in the same category

**Table 4.6e** Collation of responses to open-ended Question 8b

**Question 8b Ideally, from whom or from where would you prefer to get your information ?**

	<b>Total</b>
Doctors in person	38
Doctors by phone or pamphlet	25
Doctors surgery /medical people	5
Internet	16
Dentist / Dentist in person	25
Dentist pamphlet	8
Dental association/ association pamphlet	2
0800 number	33
Phone	1
Brochure	26
Brochure to home	1
Pamphlet/ pamphlet in mail	12
Rates notice	21
Health people/ public health people /medical officer of health	8
Health people in writing/ health department flier	6
Written information/ written from council	5
Metro water/ metro water written / leaflet	5
Water supplier/water care	2
Water people or council by pamphlet	5
Water services /water supply authority	4
Metro water 0800	1

Council talking	3
Council	2
Council-written flier / brochure	13
Leaflet through door / something direct to home	3
Library /library book	5
Scientists / researchers/ written research material	5
Trustworthy material	1
Local paper	2
Someone who does not have a vested interest (for profit)	1
Don't know	21
Not interested/ don't care	9
<i>Everything</i>	<u>3</u>
	<b><u>317</u></b>

/ = different responses in the same category

#### **4.7 Responsibility for Decision making on Fluoridation**

The results from Questions 9,10 and 11 are given as overall percentages Table 4.7a. For question nine, which asked who should make the decision on fluoridation of the local water supply, and where respondents were able to tick as many of the five categories as were appropriate, 49 percent of responses were for the *Health Authorities with Citizens* of the Area receiving 31 percent. When asked whether it was appropriate that the *City Council* make the final decision on fluoridation of the local water supply, 67 percent of respondents said *no* with only 23 percent *in favour* of the *Council* making the decision. Sixty eight percent of respondents believed there should be a *referendum* on the issue whilst 23 percent said they *did not know*.

Table 4.7b shows the percentage by age, ethnicity and marital status of the total number of responses for Question nine, which asked who should make the final decision on fluoridation. There was little difference in age

response although the 45 plus age group gave more weight to *Health Authority* (54 percent compared with 48 percent) and showed a lower preference to *citizens* of the area than the 18-44 group. (27 percent compared with 33 percent). The *Health Authority* was the preferred choice of all ethnic groups; Maori giving it the highest score (percent) compared with 39 percent for Pacific people. Asians plus Others gave a very low score to the *Government* (three percent) compared with the Pacific people who gave it the highest score (10 percent). The lowest score for *citizens* of the area was given by Maori (18 percent) whilst the highest score (42 percent) was given by the Asians plus Others.

Table 4.7c shows the analysis of Questions 10 and 11 by ethnicity. Both Europeans and Maori were *strongly opposed* to the *Council* making the final decision on fluoridation (73 percent to 70 percent respectively) compared with Pacific people (44.5 percent) and Asians plus Others (54 percent). A higher percentage of Pacific people said *yes* to the *Council* making the decision than any other ethnic group (36 percent). More Asians plus Others said they *did not know* than any other Ethnic group. Whilst the majority of Europeans and Maori said there should be a *local referendum* (70 percent and 74 percent) only 42 percent of Pacific people said *yes* to Question 11. The majority of Pacific people (55 percent) and 42 percent of Asian +Others said they *didn't know*. This is a very highly significant result.

Table 4.7d shows the analysis of Questions 10 and 11 by age and marital status. There was no significant difference in response by age to the council making the final decision (Question 10). Those who were *ever married* were more *against* the council making the final decision than those *never married* (70 percent compared with 55 percent). This difference was significant. When asked if there should be a *referendum* 72 percent of 45 plus age group said *yes* compared with 65 percent of the 45 plus age group. There was no significant difference in response by marital status.

Table 4.7e shows results of cross tabulation between Question 10 and 11 which asked if the Council should make the final decision and if there should there be a referendum on the issue. Of the 65 respondents who said *yes* to the Council making the final decision on fluoridation

- 48 percent said *yes* to the referendum
- 18 percent said *no* to the referendum
- 34 percent said they *didn't know*
- Of the 189 respondents who said *no* to the Council making the final decision on fluoridation
  - 80 percent said *yes* to a referendum
  - 7 percent *no* to a referendum
  - 13 percent said *didn't know*

### **Open-ended Questions**

Respondents were asked how important the issue of fluoridation was to them (question 12). Their responses are presented in Table 4.7f. Approximately 40 percent of respondents said that it was *not important* whilst 49 percent said that it was *important*. These responses ranged from quite important (26 percent), important (6 percent), very important (16 percent) to extremely important one percent. Approximately six percent said they *didn't know* enough about it.

Respondents were then asked (Question 14) if there were any other areas of dental health that they would like information about. Their responses are presented in Table 4.7g. The majority of respondents said *no* (71 percent), however 23 percent of respondents did give a positive response. Of these six percent gave a positive response to all prompts given, three percent said they would like more information on the effects of sugar and sugary drinks on teeth. Mention was made of more information on effective ways of caring for teeth and gums.

**Table 4.7a** Overall percentage response for Question 9, 10, 11.

**Question 9 Who do you think should make the decision as to whether or not fluoride should be added to your local water supply? (Tick as many as appropriate)**

	<b>Number</b>	<b>Percentage</b>
The Government	21	6%
City Councils	37	10%
Health Authorities	175	49%
The citizens of the area	109	31%
Other	<u>14</u>	4%
	<b><u>356</u></b>	<b>100%</b>

**Question 10 Do you think that it is appropriate that the Auckland City Council makes the final decision concerning water fluoridation in your area?**

	<b>Number</b>	<b>Percentage</b>
Yes	65	23%
No	188	67%
Didn't know	25	9%
No response	<u>4</u>	1%
	<b><u>282</u></b>	<b>100%</b>

**Question 11 Should there be a local referendum on this issue?**

	<b>Number</b>	<b>Percentage</b>
Yes	191	68%
No	26	9%
Didn't know	64	23%
No response	<u>1</u>	1%
	<b><u>282</u></b>	<b>100%</b>



**Table 4.7b** Response to Question 9 by age, ethnicity and marital status

**Question 9 Who should make the final decision on fluoridation?**

		18-44	45+	Euro*	Maori	Pacific	Asian + O*	Never *	Ever*
Government	21	6%	5%	4%	10%	16%	3%	8%	5%
City Council	36	10%	11%	9%	15%	9%	10%	6%	10%
Health Authority	175	48%	52%	51%	56%	39%	42%	33%	49%
Citizens of area	109	33%	27%	31%	18%	34%	42%	20%	31%
Other	14	3%	5%	5%	-	2%	3%	-	5%

\*Euro = European

\*O = Other

\*Never = Never married

\*Ever = Ever married

**Table 4.7c** Response to Questions 10 and 11 by ethnicity

		Euro	Maori	Pacific	Asian + Others
<b>Q10. Do you think it is appropriate that the Auckland City council makes the final decision on fluoridation?</b> (P= 0.005)	Yes	21%	20%	36%	21%
	No	73%	70%	44%	54%
	Dk*	6%	10%	20%	25%
<b>Q11. Should there be a local referendum?</b> (P= 0.000)	Yes	74%	70%	42%	54%
	No	11%	10%	3%	4%
	Dk*	15%	20%	55%	42%

\*Dk =Don't know

**Table 4.7d** Response to Questions 10 and 11 by age and marital status.

		18-44	45+	Never*	Ever*
<b>Q10. Is it appropriate that Auckland City council makes the final decision on fluoridation?</b>	Yes	26%	19%	23.5%	23%
	No	62%	74%	55%	70%
	Dk*	12% (P=0.114)	7%	21.5% (P=0.007)	7%
<b>Q11. Should there be a local referendum?</b>	Yes	65%	72%	65%	68.5%
	No	7%	13%	4%	10.4%
	Dk*	28% (P=0.021)	15%	31% (P=0.146) NS	21.2%

\*Never = never married

\* Ever = Ever married

**Table 4.7e** Cross tabulation between Questions 10 and 11

**Question 11 Should there be a referendum?**

<b>Should the council make the final decision on fluoridation?</b>	Yes	No	Don't know	N=
Yes	31 48%	12 18%	22 34%	65
No	152 80%	13 7%	24 13%	189
Don't know	8 28%	1 4%	19 68%	28
N=	191	26	65	282

**Table 4.7f** Response to open – ended Question 12.

**Question 12 How important to you is the issue of fluoridation?**

	<b>Total</b>
Not important/not at all	40
Not very important /not really	52
Not important if you use good toothpaste	1
Not important because our water is amongst the world's best	1
Minor importance	1
Too old	1
Not very unless affecting health	1
Not top priority interest/not really interested	6
Quite important	34
Quite important as I drink filtered water	1
Reasonably /fairly /moderately / of average important	33
Will be more important once better informed	1
Quite important for next generation-high cost dental care	2
Important /concerning	13
Important to people with children	4
Want kids to have healthy teeth	1
Very important	39
Extremely	3
Don't know much about it/ enough about it/ need more information	12
Don't know	1
Haven't given it any consideration	3
Important in a negative sense-don't want it	<u>3</u>
Very, as I'm "anti"	<u>257</u>

/ = different responses in the same category

**Table 4.7g** Response to open-ended Question 14

**Question14** If you were receiving information about fluoride, are there any other areas of oral or dental health you would like to know about?

	Total
No	202
Nothing specific	1
Second opinion on dentist diagnosis (free quote like other professional services)	1
Why there is a need for it / facts about fluoride	2
Broader picture about everything	1
Don't know	1
Things that keep teeth healthy other than brushing and fluoridation	1
What would keep health of teeth better than fluoride?	1
Dental hygiene	1
Everything / overall dental care	1
Toothpastes; are they very good? / effectiveness of fluoride toothpaste	4
Diet	3
<i>All of the prompts</i> (effects of sugar, sugary drinks, brushing, toothpaste, gum disease, bad breath)	2
Effects of sugar/sugary drinks on teeth	18
Food types that cause it	8
Effects of other chemicals, other than sugar, on teeth and gums	1
Brushing techniques / effects of brushing/ when to brush	1
Benefits of flossing	8
More about hygiene / dental hygiene	1
More effective ways of caring for teeth	4
Care of teeth and gums/receding gum line	1
Gum disease/ bad breath	3
Types of dental decay / where dental decay comes from/how to prevent decay	7
Food types that cause it	3
I'm a dental therapist	1
Cosmetic dentistry	1
	1

# 5. RESULTS OF BUSINESS QUESTIONNAIRE

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## 5.1 Introduction

A random telephone survey of 50 businesses was carried out to find out if fluoridation is an important issue in their business operation. The results of this survey are presented as percentages with the questions being grouped according to the issues covered. Most of the issues covered parallel those of the personal questionnaire, Questions two to eleven being the same. To gauge any difference in response between business people and residents a straight percentage comparison of the responses to the same questions is presented at the end of this section.

## 5.2 Description of sample

The sample consisted of 50 businesses from the Onehunga Borough. Respondents were selected at random using numbers supplied by Telecom. No demographic quotas were required.

## 5.3 Knowledge of water used by business

Questions 1 and 1b were asked in an attempt to find out from the business community the knowledge of the type of water supply they used and why. Results are presented in table 5.3a Surprisingly none of the respondents said they used private spring water with 86 percent saying they were on

reticulated supply, hence there were no responses to question 1b which asked to give reasons for using private spring water.

**Table 5.3a** Response to Questions 1 and 1a

**Question 1 What sort of water do you use for your business?**

	<b>Number</b>	<b>Percentage</b>
Private Spring	0	0%
Reticulated	43	86%
Don't know	7	14%

**Question 1b What are your reasons for using private spring water?**

No response

## **5.4 Regional fluoride issues**

Response to Questions two, three and four are given as percentages in Table 5.4a.

The majority of respondents said they knew why most areas in Auckland had fluoridated water (60 percent saying *yes*, with 40 percent saying *no*). Only 10 percent said their water supply was *not* fluoridated with 68 percent saying they *did not know*. Whilst 47 percent were *in favour* of fluoridation the rest of the opinions were equally divided between *no* and *don't know*.

### **Open ended Questions**

Those who said they knew the reason for fluoridation gave their responses in Question 2b, which are presented in Table 5.4b. Of the 36 positive responses given to this question, 72 percent said that fluoridation had dental benefits such as protecting teeth and preventing dental decay whilst 28 percent said it was to treat the water –killing germs and bacteria.

In Question 4b respondents were asked to explain why they were or were not in favour of fluoridation. Their responses are collated and presented in Table 5.4c. Of those who were in favour of fluoridation of water supply to their business 57 percent said that it was beneficial for teeth, 26 percent said that it improved health, whilst 17 percent said that it killed bugs and bacteria. Of those that gave a negative response 33 percent felt that it wasn't beneficial to health, where as 47 percent said they didn't need it as they had a water filter, purifier or the water was boiled. Nine respondents (25 percent) said that they didn't know enough about it to comment.

**Table 5.4a** Response to Questions 2,3 and 4

**Question 2 Most areas in Auckland have fluoridated water. Do you know the reason?**

	<b>Number</b>	<b>Percentage</b>
Yes	30	60%
No	<u>20</u>	40%
	<b>50</b>	<b>100%</b>

**Question 3 Is the water supply coming to your business fluoridated?**

	<b>Number</b>	<b>Percentage</b>
Yes	11	22%
No	5	10%
Don't know	34	68%
	<b>50</b>	<b>100%</b>

**Question 4 Would you be in favour of the fluoridation of water supply coming to your business?**

	<b>Number</b>	<b>Percentage</b>
Yes	23	47%
No	13	26.5%
Don't know	13	26.5%
No response	<u>1</u>	-
	<b>50</b>	<b>100%</b>

**Table 5.4b** Reasons given for water fluoridation

**Question 2b Most of Auckland has fluoridated water, do you know the reason for this?**

Yes	60%
No	40%

**The following reasons were given for answering “yes”**

	<b>Total</b>
Children’s teeth/ good for children’s teeth/protects children’s teeth	4
Sanitation	1
Cleans water/treats the water	3
Teeth	6
Beneficial for teeth/ protects teeth /dental benefits	7
Kills bugs and germs/ bacteria	6
Prevents tooth decay	7
Dental benefits	<u>2</u>
	<b><u>36</u></b>



**Table 5.4c** Reasons given for favouring or not favouring a fluoridated water supply

**Question 4** Would you be in favour of the fluoridation of the water supply to your business?

Yes	38%
No	22%
Don't know	40%

**Question 4b** Reasons for answer given:

	<b>Total</b>
<b>Yes:</b>	
Helps with teeth/ good for teeth	5
Keeps teeth healthy	4
Health reasons/Improves health	4
Good for children's teeth	2
Better for you doing more good than harm	1
Kills bugs / bacteria	2
Need clean water as we are close to sewage ponds	1
Makes it safe to drink	1
Impact on dental care great after fluoride introduced in UK	1
Dental hygiene	1
Fewer trips to dentist	1
	<b><u>23</u></b>
<b>No:</b>	
Water boiled before drunken	1
No, have filter at work/ water purifier	3
No, we have clean water to premises	1
Have water purifier; wouldn't it get taken out?	1
No, not beneficial to health; only teeth	3
Too old to worry about it	1
Fluoride already in tooth paste	1
As long as it comes out of the tap that is all that matters	1
No, water not used much at work-mainly for washing hands	1

Come from UK, I remember controversy	<u>1</u>
	<b><u>14</u></b>
<b>Don't know:</b>	
Don't know enough about it	8
Don't know because fluoride benefits children's teeth. No children here.	<u>1</u>
	<b><u>9</u></b>

## 5.5 Health benefits and hazards

The responses to Questions five and six are found in Table 5.5a. Fifty eight percent of respondents believed there were health *benefits* from adding fluoride to the water, 24 percent believed there were health *hazards*.

### Open ended Questions

Respondents were asked in Question 5b what they thought the health *benefits* were. Their responses are collated and presented in Table 5.5b. Almost three-quarters (71 percent) of the respondents stated that the benefits of fluoride were for teeth, and preventing decay. Others believed it was important for health and safety.

Respondents were asked in Question 6b what they believed the health *hazards* were associated with fluoridation. Their responses are presented in Table 5.5c.

Of the 24 percent who believed that fluoride was *hazardous*, approximately 60 percent were concerned about overdose and long term effects of fluoride on the body.

**Table 5.5a** Response to Questions 5 and 6

**Question 5. Do you think that there are any health benefits from adding fluoride to the water?**

	<b>Number</b>	<b>Percentage</b>
Yes	29	58%
No	11	22%
Don't know	<u>10</u>	20%
	<b><u>50</u></b>	<b>100%</b>

**Question 6 Do you think that there are any health hazards from adding fluoride to drinking water?**

	<b>Number</b>	<b>Percentage</b>
Yes	12	24%
No	19	38%
Don't know	<u>19</u>	38%
	<b><u>50</u></b>	<b>100%</b>

**Table 5.5b** Health benefits from fluoridated water

**Question 5 Do you think that there are any health benefits from adding fluoride to the drinking water?**

Yes	58%
No	22%
Don't know	20%

### Question 5b If “yes”, what are the reasons?

	<b>Total</b>
Teeth /dental	18
Prevents tooth decay	4
Keeps teeth strong	2
Health	3
Calcium for teeth	1
Drinking clean water	2
Important for safety of children	<u>1</u>
	<b><u>31</u></b>

**Table 5.5c** Health hazards from fluoridated water

### Question 6 Do you think there are any health hazards from adding fluoride to the drinking water?

Yes	24%
No	38%
Don't know	38%

### Question 6b If “yes” what do you think the reasons are?

	<b>Total</b>
Large amount/ overdose could be bad for you	6
Not good for bones	1
Long term effects on internal/ long term effects not good for you	2
Chemicals sometimes have side effects	1
Can cause cancer	1
Drinking water should be pure	1
Not good for internal organs	<u>1</u>
	<b><u>13</u></b>

## 5.6 Expected sources of information

The answers to Question seven are given in Table 5.6a. Respondents were asked whom they would speak to if they had to decide whether their

water supply was to be fluoridated. Forty seven percent chose the *Water Supply Authority* with 29 percent choosing the *Council* and nine percent choosing the *Doctor*.

### **Open ended Questions 8 and 8b**

In Question eight respondents were asked, if they wanted to know more about fluoridation, what sort of information would they like. Their responses are summarised in Table 5.6b. The majority of respondents wanted to know the advantages and disadvantages and health issues such as long term effects on the body. When asked where or from whom they would ideally prefer to get their information (Question 8b) the majority, (64 percent) wanted *written information*, largely in *brochure* form. Ten percent of respondents stated *0800 number* while a further ten percent preferred the *rates notice*. These responses are found in Table 5.6c. Most of the responses referred to *places* rather than *people*. *Citizens Advice bureau* and *Green Peace* were mentioned as *other* places respondents would prefer to get information from.

**Table 5.6a** Where information on fluoride would be accessed

### **Question 7 Currently where would you go or whom would you speak to if you had to decide whether your water supply was to be fluoridated or not?**

Friends	1	1.5%
Family	1	1.5%
Dentist	2	3.0%
Chemist	0	0%
Doctor	6	9.0%
Medical officer of health	2	3.0%
Water supply authority	30	47%
Council	18	29%
Media	0	0%

Health shop	0	0%
Medical centre	0	0%
Library	1	1.5%
Internet	1	1.5%
Other		0%
Citizen's Advice	2	3%
Green Peace	4	6%

**Table 5.6b** Information sought on fluoride

**Question 8** If you wanted to know more about water fluoridation,  
what sort of information would you like?

	<b>Total</b>
Overall information / pros and cons /advantages and disadvantages	23
Health facts /truth	9
Everything in laymen's terms / the basics	1
Health issues / impact /effect on body / long term effects on body	6
Safety of water	2
Benefits	3
Every thing from processing to health	1
Percentage of fluoride	1
Scientific research / test results	2
Costs	1
Not sure/ not interested	2
Memoirs of the late Sir Dove Myer	<u>1</u>
	<b><u>54</u></b>

**Table 5.6c Preferred place to access information**

**Question 8b Ideally who/ where would you prefer to get your information from?**

	<b>Total</b>
Brochure	25
Rates notice/water rates	7
Newspaper	1
Public knowledge	1
Bro.	1
0800 number	6
Auckland City	1
Science news paper/ scientific journal/ government research	3
Internet	1
Newsletter	2
Email	1
Schools etc.	1
See someone in person	1
Video	1
Cheapest option	1
Dentist	1
Library	1
Dept.of Health	1
Radio	1
Leaflet	<u>2</u>
	<b><u>59</u></b>

## **5.7 Responsibility for making decisions on fluoridation**

Responses to Questions nine, ten and eleven are found in Table 5.7a. The business respondents said that the *citizens* of the area should make the final decision on fluoridation (43 percent) followed by *Health Authorities* (34 percent). Whilst 40 percent believed that it was appropriate that the

*Council* make the final decision on fluoridation, 52 percent did not. Eighty two percent said that there should be a local referendum on the issue.

### Open ended Question

Respondents were asked how important to their business was the issue of fluoridation. Their responses are recorded in Table 5.7b. Eighty percent of respondents said that it was not important. Only 14% felt that it was of importance.

**Table 5.7a** Who should make the final decision.

**Question 9 Who do you think should make the decision as to whether or not fluoride should be added to your local water supply? (tick as many as are appropriate)**

	<b>Number</b>	<b>Percentage</b>
The Government	11	14%
The City Council	7	9%
Health Authorities	26	34%
Citizens of the area	33	43%
Other	<u>0</u>	0%
	<b><u>77</u></b>	<b>100%</b>

**Question 10 Do you think that it is appropriate that the Auckland City Council makes the final decision concerning water fluoridation in your area?**

	<b>Number</b>	<b>Percentage</b>
Yes	20	40%
No	26	52%
Don't know	4	8%
	<b><u>50</u></b>	<b>100%</b>



**Question 11 Should there be a local referendum on this issue?**

	<b>Number</b>	<b>Percentage</b>
Yes	41	82%
No	9	18%
Don't know	0	0%
	<b><u>50</u></b>	<b>100%</b>

**Table 5.7b** The importance of fluoridation

**Question 12 How important to your business is the issue of water fluoridation?**

	<b>Total</b>
Not important	41
Not important as I have water filter	1
Long as it is safe to drink	1
Fairly important/ quite important	2
Very important for safety of children	1
Very important because we need to pump power to suppliers	1
Very important as water needs to be safe for staff to drink	<u>3</u>
	<b><u>50</u></b>

**5.8 Comparison of attitudes between business and personal respondents.**

Questions two to eleven were the same for both personal and business questionnaires. Table 5.8a compares the responses made by the two groups. Similarities and differences are summarised at the end of the table.

**Table 5.8a** Comparison of attitudes between business and personal respondents

**Question 2 Most areas in Auckland have fluoridated water.**

**Do you know the reason for this?**

	<b>Business</b>	<b>Personal</b>
Yes	60%	78%
No	40%	22%

**Question 3 Is the water to your business/ home fluoridated?**

	<b>Business</b>	<b>Personal</b>
Yes	22%	26%
No	10%	27%
Don't know	68%	46%
No response	0%	1%

**Question 4 Would you be in favour of fluoridation of your water supply?**

	<b>Business</b>	<b>Personal</b>
Yes	47%	48%
No	26.5%	21%
Don't know	26.5%	30%
No response	0%	1%

**Question 5 Do you think there are health benefits from adding fluoride?**

	<b>Business</b>	<b>Personal</b>
Yes	58%	64%
No	22%	10%
Don't know	20%	25%
No response	0%	1%

**Question 6 Do you think there are any health hazards from adding fluoride?**

	<b>Business</b>	<b>Personal</b>
Yes	24%	24%
No	38%	20%
Don't know	38%	55%
No response	0%	1%

**Question 7 Currently where or whom would you go to for information?**

	<b>Business</b>	<b>Personal</b>
Friends	1.5%	2%
Family	1.5%	1.5%
Dentist	3%	13%
Chemist	0%	1.5%
Doctor	9%	13%
Medical officer of health	3%	6%
Water supply authority	47%	17%
Council	29%	18%
Media	0%	1.5%
Health shop	0%	1%
Medical centre	0%	2%
Library	1.5%	4.5%
Internet	1.5%	5%
Other	3%	13%

**Question 9 Who should make the final decision?**

	<b>Business</b>	<b>Personal</b>
The Government	14%	6%
The City Council	9%	10%
Health Authorities	34%	49%
Citizens of the area	43%	31%
Other	0%	4%

**Question 10 Do you think it appropriate that the council makes the final decision regarding water fluoridation?**

	<b>Business</b>	<b>Personal</b>
Yes	40%	23%
No	52%	67%
Don't know	8%	9%
No response	0%	1%

**Question 11 Should there be a local referendum on this issue?**

	<b>Business</b>	<b>Personal</b>
Yes	82%	68%
No	18%	9%
Don't know	0%	23%

**Summary**

- Q2. When asked if they knew the reason for fluoridation there was a greater positive response from residents than businesses.
- Q3. When asked if the water to their homes/ businesses was fluoridated a high percentage of businesses *didn't know* (68 percent compared with 46 percent of residents)
- Q4. When asked if they would be in favour of fluoridation of their water supplies almost half of both residents and businesses said yes

- Q5. The majority of both businesses and residents believed that there were benefits from adding fluoride to the water supply.
- Q6. Twenty four percent of both residents and businesses believed that there were hazards associated with fluoridation. The majority of residents however said they *didn't know*.
- Q7. When asked where or to whom they would currently go for information on fluoridation the businesses favoured the *Water supply authority* (47 percent) and the *Council* (29 percent). Opinions were more evenly spread in the personal responses ranging from the *Council* (18 percent), the *Water supply authority* at 17 percent, the *Dentist*, the *Doctor* and *other* all at 13 percent.
- Q9. When asked who should make the final decision on water fluoridation the *Health authorities*, followed by *Citizens of the area*, were preferred by residents (49 percent and 31 percent respectively) whilst businesses preferred *Citizens of the area* (43 percent) followed by *Health Authorities* (34 percent).
- Q10. When asked if it is appropriate that the council makes the final decision both residents and businesses said *no* emphatically (52 percent and sixty seven percent). Almost twice as many businesses than residents said *yes* (40 percent).
- Q11. Both businesses and residents believed strongly that there should be a referendum on this issue (82 percent and 68 percent respectively). Whilst the businesses were sure of their opinion 23 percent of residents said that they *did not know*.

## 6. DISCUSSION

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### 6.1 Introduction

Fluoridation of water supplies began in New Zealand in 1954 with an estimated 57% of the population receiving fluoridated water by 1999 (Wright et al, 1999). One of the objectives of the draft New Zealand Health strategy is to increase the proportion receiving fluoridated water. How to involve the public in the decision-making process when implementing new water fluoridation schemes is an ongoing issue.

Data from a 1999 school dental survey for children in Auckland City showed that children from non fluoridated areas such as Onehunga had a higher portion of dental caries than those from areas of fluoridated water supply and this was especially so for Maori and Pacific children (Dalton, J personal communication with D Campbell, 2000). The Auckland City council wishes to fluoridate the remaining non fluoridated areas such as Onehunga where there have been numerous requests from local residents and interested parties to fluoridate the water supply. The results of this Onehunga study give insight into the current attitudes and beliefs of the people of Onehunga on the issue of water fluoridation. It highlights areas where information is lacking and what sort of information people would like and where they would expect to access this information.

### 6.2 Knowledge of Dental Health

The personal questionnaire began with a question on fluoride toothpaste to introduce the subject within the context of oral care and to find out how

many people within the population used it or were aware of their toothpaste being fluoridated.

In early 1998, it was estimated that fluoride was present in 95% percent of toothpaste sold in New Zealand (Progress on health outcome targets, 1998). It is recommended that 1,000ppm toothpaste be used, but that a smaller amount of toothpaste is used for younger children to limit the amount ingested. (PHC, 1995) The use of fluoride toothpaste by children is associated with average caries prevention of 25% over a 25year period. (Murray et al, 1991) In non-fluoridated areas fluoride toothpaste is believed to be the main method of decay prevention (Murray et al, 1991)

Unfortunately, a significant proportion of certain population groups does not use fluoride toothpaste. Data from a Porirua survey show that 36 percent of Pacific children, 23 percent of Maori compared with five percent of European children in Porirua do not use a fluoride toothpaste or even brush their teeth daily. (Campbell, 2000),) (Progress on Health Outcome Targets, 1998)

Results from the Onehunga survey show that 65 percent of the population said yes, they did use fluoride toothpaste. Fifteen percent said they did not, whilst 19 percent said they didn't know whether they used fluoride toothpaste or not. Analysis of the results by ethnicity showed that almost one third of Maori, Pacific people and Asians and others did not know whether or not their toothpaste was fluoridated. As 95 percent of toothpaste is fluoridated probably, more use it than realise that they do or they do not use toothpaste. A higher percentage (seventy one percent) of those in the younger age group (18-44) said they used fluoridated toothpaste compared with those in the 45 plus group (56 percent). Respondents were not asked whether they had their own teeth or not which may be a confounding factor.

Scientific investigations have shown significant reductions in dental decay rates to both primary and permanent teeth of children exposed to

fluoridated water. The general decline in caries is attributed to the widespread use of fluoride containing toothpaste as well as the direct benefit of fluoridated water. When respondents in this survey were asked to select what they considered the best way to prevent dental decay from a list of five categories, (including oral health, dental visits, diet and fluorides), 64 percent of respondents said oral hygiene. Dental education was the most commonly suggested "other" way of preventing dental decay.

### **6.3 Regional fluoride issues**

At present the Onehunga water supply, coming from the unique supply of the Onehunga springs, is the only water supply zone within the Auckland City which is non-fluoridated. (It has a natural fluoride level 0.12mg/L compared with a target of 0.7-1.0mg/L). The Onehunga Borough has refused requests to fluoridate in the past but a recent application from some residents has been forwarded to the Auckland City Council by the community board. The Ministry of Health "health outcome " target for fluoride is to increase the proportion of the population on reticulated water supply with fluoridated water from 56 percent in 1998 to 70 percent in the year 2000. The justification for this being that the Ministry of Health has a large body of scientific material from peer reviewed articles to show that there is overwhelming evidence for the effectiveness and safety of water fluoridation.

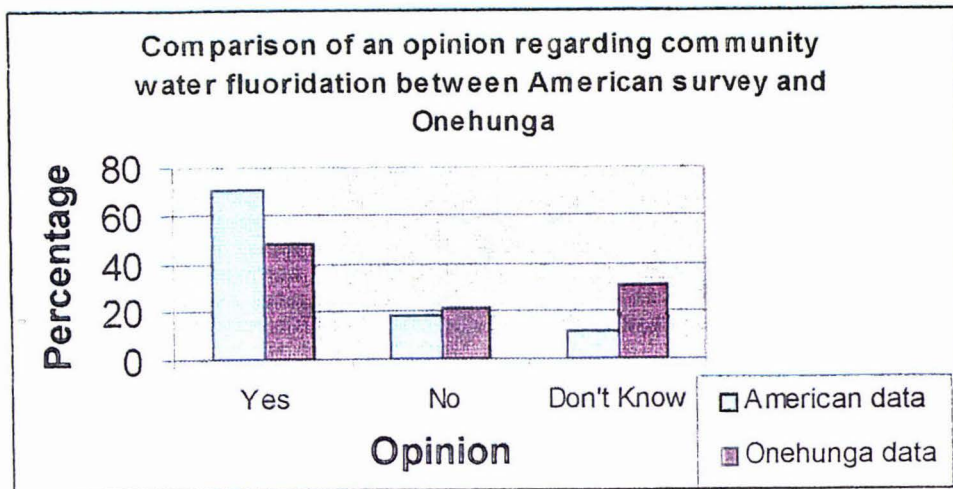
In this survey of residents from the Onehunga Borough, while it was found that overall the majority of respondent said they did know the reason for fluoridation, the majority of respondents were unaware of the fact that their water supply was non-fluoridated. Maori and European appeared to be better informed on this issue than Pacific people and Asians and others. A high percentage of Maori, Asian and others and Pacific people said they did not know the reason for fluoridation compared with Europeans. These differences were highly significant. There was a highly significant



difference in the response given by the two age groups. The older respondents being more aware of the issues and understanding the reasons for fluoridation than the 18-44 age group. Similarly those who were or had been married were more likely to say they knew the reasons for fluoridation than those never married. Residents were more likely to know if their water supply was fluoridated than the business respondents were, with only 10 percent of businesses saying that their water was not fluoridated. It was surprising that none of the business respondents were aware that they were on private spring water.

Results from extensive US surveys show that the majority of Americans approve of water fluoridation. In a survey in 1998 in which the Gallup Organisation conducted a national survey of 1000 adults on their attitudes towards community water fluoridation the results showed that 70 percent were in favour, 18 percent were against whilst 12 percent said they didn't know. Disapproval ranged from four percent in communities where water was fluoridated to 16 percent in communities where it was not (American Dental association, 1999).

When respondents from Onehunga were asked whether they were in favour of fluoridation, 48 percent said they were, 21 percent were against whilst 31 percent did not know. Compared with the US survey a high percentage of the Onehunga residents surveyed did not know whether they were in favour of fluoridation or not. (See figure 6.1) The older age group was more likely to be anti fluoride (26 percent) compared with 16 percent of the 18-44 age group. The level of opposition to fluoridation was comparable to that found in Quebec by Levallois et al (1998).



**Fig. 6-1** Comparison of opinion on fluoridation between Onehunga and American data

Of the respondents who said they knew the reason for fluoridation approximately 60 percent of them said that it promoted strong healthy teeth, 17 percent said that it reduced decay whilst 10 percent said that it kept water clear and killed germs. The response from the business community was similar except that a higher portion believed that fluoride was used to treat the water and kill germs. This could reflect a confusion some respondents may have between fluoride and chloride and would suggest the need for public education on terminology.

The work of Riley et al (1999) showed that fluoride lessened dental caries in more materially deprived areas in England than in affluent ones. This difference can also be seen in the Auckland region where there are appreciable differences in the proportion of five year old children who are caries free both by race and socio-economic status and also whether or not their home water supply is fluoridated (Dalton J, personal communication with D Campbell).

There were significant differences in the distributions of knowledge and attitudes to fluoridation among racial groups. As seen in Table 6.1 New Zealand European and Maori groups did not vary significantly in the areas

examined apart from knowing the reasons for fluoride use and favouring the use of fluoride. Pacific people and Asians and others differed significantly from Europeans across all issues; Europeans were more definite in their knowledge and opinions while Pacific people responded "don't know" more frequently. This survey shows that the Pacific adults, whose children might benefit most, have the least knowledge on the topic (Campbell et al, draft paper,2000). See Table 6.1 below

**Table 6.1** Responses of residents by ethnicity.

		<b>Euro</b>	<b>Maori</b>	<b>Pacific</b>	<b>Asian + O*</b>	$\chi^2$
<b>Use fluoride toothpaste</b>	Yes	69%	63%	53%	54%	
	No	17%	7%	17%	13%	*
	DK	14%	30%	30%	33%	
<b>Know reasons for fluoride</b>	Yes	90%	70%	39%	50%	
	No	10%	30%	61%	50%	**
<b>Is supply fluoridated</b>	Yes	31%	27%	11%	4%	
	No	32%	33%	11%	4%	**
	DK	37%	40%	78%	92%	
<b>In favour of fluoridation</b>	Yes	55%	33%	33%	38%	
	No	23%	23%	11%	13%	**
	DK	22%	43%	56%	50%	
<b>Any health benefits</b>	Yes	73%	63%	33%	42%	
	No	11%	7%	8%	8%	**
	DK	16%	30%	58%	50%	
<b>Any health hazards</b>	Yes	28%	37%	6%	4%	
	No	22%	17%	14%	13%	**
	DK	50%	46%	80%	83%	
<b>Appropriate for Council to make decision</b>	Yes	21%	20%	36%	21%	
	No	73%	70%	45%	54%	**
	DK	5%	10%	20%	25%	
<b>Want local referendum</b>	Yes	74%	70%	42%	54%	
	No	11%	10%	3%	4%	**
	DK	15%	20%	55%	42%	
<b>Total</b>		192	30	36	24	

The younger age group's knowledge and strength of opinion on fluoridation was significantly less certain than their older counterparts with a greater percentage responding don't know to most questions. The lesser ability of younger people to specify the main purpose for water fluoridation is in accord with the Australian experience (Roberts-Thomson et al, 1999)

**Table 6.2** Responses of age and marital group of residents

		<b>18-44</b>	<b>45 +</b>	$\chi^2$	<b>Never</b>	<b>Ever</b>	$\chi^2$
		<b>Yr</b>	<b>Yr</b>		<b>married</b>	<b>married</b>	
<b>Use fluoride toothpaste</b>	Yes	71%	56%	**	72%	64%	NS
	No	8%	27%		14%	15%	
	DK	21%	17%		14%	21%	
<b>Know reasons for fluoride</b>	Yes	71%	88%	**	59%	82%	**
	No	29%	12%		41%	18%	
<b>Is supply fluoridated</b>	Yes	24%	29%	**	23%	26%	NS
	No	22%	35%		18%	30%	
	DK	54%	36%		59%	44%	
<b>In favour of fluoridation</b>	Yes	49%	47%	*	39%	50%	**
	No	16%	28%		12%	23%	
	DK	35%	25%		49%	27%	
<b>Any health benefits</b>	Yes	57%	75%	**	47%	68%	**
	No	9%	11%		6%	11%	
	DK	34%	14%		47%	21%	
<b>Any health hazards</b>	Yes	21%	29%	*	16%	25%	NS
	No	16%	25%		19%	20%	
	DK	63%	46%		65%	55%	
<b>Appropriate for Council to make decision</b>	Yes	26%	29%	NS	24%	23%	**
	No	62%	74%		55%	70%	
	DK	12%	7%		22%	7%	
<b>Want local referendum</b>	Yes	65%	72%	*	65%	69%	NS
	No	7%	13%		4%	10%	
	DK	28%	15%		31%	21%	
<b>Total</b>		170	112		51	231	

DK = Don't Know  $\chi^2$  NS not significant, \*P  $\leq$  0.05, \*\*  $\leq$  0.01

## 6.4 Health benefits and hazards

Opinions are frequently divided over the issue of fluoridation of drinking water although a vast body of scientific literature endorses water fluoridation as a safe scientific means of reducing the incidence of tooth decay. (Shaw, Sweeney, 1980) (Wright, Bates et al, 1999). A vocal minority, however believe it is hazardous and speak out against fluoridation of municipal water supplies. Although much of their opposition is based on ethical issues such as freedom of choice, they very often use scare tactics citing largely unsubstantiated hazards caused by fluoridation such as bone fracture and cancer. Bohannon (1985) believes that health care decisions should be made on overall benefit to the community rather than individual rights.

Studies of public and professional knowledge of relative effectiveness of fluorides show that few efforts have been routinely made to educate the public about their value, especially their value relative to other methods of dental decay prevention. In effect unless there is controversy, little or no information is available on the topic regardless of whether the community water supply is fluoridated or not.

The Onehunga survey was carried out prior to the Auckland city councils fluoride poll (and subsequent publicity for and against fluoridation). It asked respondents if they believed there were any health benefits from adding fluoride to the drinking water and if so what were they? Similarly, if they believed there were any health hazards associated with fluoridation and if so, what they thought they were.

The majority of respondents did believe there were health benefits from adding fluoride to drinking water. Although the business respondents were less certain of health benefits they also considered health hazards to be less likely. There were highly significant differences between racial groups in their awareness of health benefits from fluoridation with a very highly significant portion of Pacific people and Asians and others stating that they

did not know of benefits of fluoridation. Similarly it was those who were in the 45 plus age group and those who were married who were more likely to be aware of the health benefits of fluoridation than the younger and unmarried groups. Approximately one quarter of the respondents said they believed there were health hazards associated with water fluoridation, however the majority of respondents said that they did not know. The business respondents were more likely to have an opinion than to say they did not know. The positive response to issue of hazards came from Maori (particularly) and European with over 80 percent of both Pacific people and Asians and others stating that they did not know. It appears that in response to these questions a high percentage of Pacific people, Asians and others also the young and never married groups have little information on the issues of fluoridation. The significant difference in the familiarity with fluoridation among the four ethnic groupings has important implications when consulting residents on their wishes on the topic. (Campbell et al, 2000)

Of those who believed there were health benefits from fluoridation the main points mentioned were as follows:

- Keeps teeth healthy /healthier teeth
- Helps to prevent cavities
- Strengthens teeth, good for teeth, protects teeth-particularly children's
- Keeps water pure, clean, decontaminated and kills germs

Of those who believed there were health hazards associated with fluoride the main points mentioned were as follows:

- Many respondents knew there were hazards but couldn't remember details
- Dangerous if consumed in excess
- Dangerous chemicals, toxin
- Affects general health-headaches, liver damage, toxic build-up, cancer
- Affects taste and affects the smell of water
- Detrimental to bones as you get older
- Teeth mottling and discolouration
- Rots teeth

## **6.5 Expected sources of information**

The successful implementation of water fluoridation depends upon support from the public. The significant difference in the familiarity with fluoridation among the four ethnic groupings has important implications when consulting residents on their wishes on this topic. Centres for Disease control state that "water fluoridation remains the most equitable and cost effective method of delivering fluoride to all members of most communities, regardless of age, education attainment, or income levels." (Achievements in public health.1900-1999) If this is to be achieved in New Zealand, education is required to empower the community to request it be implemented (Campbell et al, 2000).

Overseas research has shown that there is a lack of public information on fluoridation (Bohannon, 1985) and it is feared that gains made in the prevention of dental caries could be threatened unless there is continued education on the subject.

The Onehunga research showed that whilst 78 percent of respondents said they knew the reason for fluoridation the majority did not know whether or not their local water supply was fluoridated. The residents, however, were more likely to know if their water supply was fluoridated than the business respondents were. As the water supply zone in Onehunga is not fluoridated this shows that there is a lack of information within the community. Whilst 48 percent said they would be in favour of fluoridation 30 percent said they did not know and 21 percent were against.

Due to the activities of antifluoridationalists there has been a call for reassessment of the way by which the professions, public agencies, governing bodies and communities educate the citizens on issues of water fluoridation. Frazier, (1985) states that "failing to inform the public and to



ensure the optimum usage of fluoridation represents a potential form of healthcare negligence.” She believes that collaborative contribution is required of dentists, scientists, educators, healthcare practitioners, the dental industry and health insurers. Research in the US has shown that the public probably learns about fluoridation treatment such as toothpaste through advertising and water fluoridation through confusing sporadic media releases. The outcome being that whilst fluoride treatment is seen as legitimate, water fluoridation is seen as questionable. As fluoridation is a proven caries prevention method, education about the basic public health measures is relevant in both fluoridated and non-fluoridated communities.

In New Zealand, the Public Health Commission health promotion initiatives targeting the general public and providing information about water fluoridation, are seen as urgent by the Ministry of Health. Suggestions include media release, simple pamphlets (pharmacies, libraries, health professional’s rooms) outlining advantages and disadvantages and including advice on alternative sources for unfluoridated areas. The promotion of fluoridation should not be isolated from overall health such as oral hygiene, nutrition and diet. (PHC, 1995)

Given a list of thirteen possible places or people where information could be sourced the Onehunga study shows that currently, respondents would go to the council for information on water fluoridation followed by the water supply authority, the doctor then the dentist. When comparing these results with the business community they preferred getting their information from the water care authority (47 percent) followed by the council with fewer mentioning the doctor. The business community chose organisations rather than people. Neither the Internet nor the library exceeded five percent as a source of information for either group.

The places and people selected as information sources differed significantly amongst the racial groups surveyed. Whilst Europeans preferred the council and the water supply authority followed by the dentist

and the doctor, Maori preference was for the doctor followed by the water supply authority then the council. Over one fifth of Maori said they didn't know. The Pacific people were the group to give the highest preference rating to the water supply authority (28 percent) followed by the council. The Asians and others preferred getting their information from the council, followed by the doctor, the water care authority and medical officer of health, (in descending order.) This information suggests that currently citizens of the area would expect to get their information from local bodies such as the council and the water care authority and health professionals such as doctors and dentists. It is interesting to note that the doctor is ranked higher, as a source of information than the dentist. This could suggest that the dentist's role is seen as some one who treats decayed teeth rather than offers advice on its prevention or that the doctor is the health professional more frequently visited. It suggests that dentists and The Dental Association could play a much larger role in getting dental education out to the public. Special care should be taken to get this information to new immigrants and those whose first language is not English.

In the Onehunga survey when asked in an open-ended question from where and how they would ideally like to get information the greatest preference was for the doctor (in person) followed by a pamphlet from the doctor. The dentist (in person) was also seen as a source of information. The dentist is not seen as a place where an information brochure is available. Also mentioned were the council, the health department and the water supplier. Many respondents also wanted to get information via an 0800 number. When comparing these responses with those made by the business community it was found that the business people mentioned places rather than people and were largely in favour of receiving written information in a brochure form. Also mentioned were 0800 number and rates notice.

When asked what sort of information they would like on fluoridation, the personal respondents wanted information on the pros and cons of

fluoridation, the benefits and the hazards, the risks and any side effects of fluoridation. They also wanted to know how effective it was and what was considered a safe dosage. A considerable portion of the respondents said that they either hadn't thought about it didn't know what information they wanted or were not interested compared with the business community where only one person said they were not interested. They wanted the facts, the pros and cons and the health issues such as long term effects on the body.

This survey indicated that people want wide ranging information on fluoride including the pros and cons and health effects. Although a considerable portion of the residents said they hadn't thought about it, didn't know what information they wanted or were not interested, only one business person said they were not interested.

## **6.6 Responsibility for making decisions on fluoride**

Legal advice states that when making decisions on whether or not to fluoridate a local water supply the Council must have regard to all "relevant considerations". This includes a referendum result if one is held. It is however considered inappropriate to exclude other relevant considerations; the weight attributed to these considerations being at the discretion of the councils.

In recent times in New Zealand there have been four referenda in local communities on whether water fluoridation should be introduced, continued or discontinued. One community voted to continue it, one voted to discontinue it and one decided to remain unfluoridated. The most recent referendum in New Zealand was held in Matamata-Piako district during February/ March, 1996. This was a telephone referendum with a response rate of only 30 percent. Of these, 70 percent were against and thus the Council decided to cease fluoridation. This is a case of a small section of the population voting and influencing the Council. Bonhamnan, 1985 in a

symposium on “The new fight for fluorides” states that referenda on scientific and technical issues such as water fluoridation should be avoided and the decisions be made by Public Health Authorities. (For example there have been three referenda in Tauranga in five years.) Other methods used for fluoridation decision making include a citizens panel, and a mixed citizens’/ expert panel. This was used to review water fluoridation for Petone and to examine submissions from the public. (Report of the review panel, 1993).

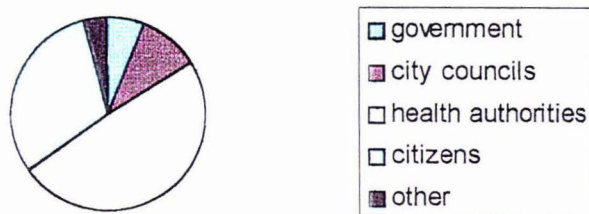
The Auckland City Council intends holding a non-binding referendum in the Borough of Onehunga to gauge citizen’s attitudes to the fluoridation of their water supply. The results from this survey show clearly that the citizens of Onehunga are in favour of a referendum (68 percent). The business community was even more strongly in favour. Maori and European were more strongly in favour than the Pacific people. The majority of Pacific people and Asians plus Others said that they didn’t know whether they wanted a referendum.

In the United States, whilst the judicial system has continued to support fluoridation as being safe, effective, economical and a legal public health activity, efforts to market fluoridation to the public via a referendum are more likely to fail than succeed (Bohannon, 1985). Fluoridation had become not only a scientific but also a political issue, with anti fluoride groups capitalising on current health concerns in marketing the anti-fluoride message.

In the Onehunga study, when asked if it was appropriate that the council make the final decision this was strongly opposed by both residents and businesses and yet the council was one of the preferred places to get information from. Almost twice the percentage of businesses, compared with residents, said yes to the council making the final decision (40 percent). The residents felt that the health authorities, followed by the citizens of the area should make the final decision. (See figure 6.2) The

businesses however, selected the citizens followed by the health authorities.

### Opinion on who should make the final decision on fluoridation



**Fig. 6-2** Opinion on who should make the final decision on water fluoridation from Onehunga survey, 2000

When the question relating to the referendum was cross tabulated with whom should make the final decision on fluoridation it showed that respondents in favour of a referendum were opposed to the council making the final decision. Although both groups were in favour of a referendum, the residents were significantly less in favour of a referendum and were less in support of the council making the final decision than the businesses.

The qualitative study in England of Lowery et al (2000) demonstrated that the general public wish to be informed of water fluoridation plans but do not see themselves as the appropriate decision makers. Onehunga showed similar views with users wishing to be consulted by a referendum as proposed. Decision making by either health professionals or the citizens themselves rather than elected representatives was preferred. This is in accord with the findings of Hastings et al (1998).

Opinions on the importance of the issue of fluoridation ranged from being not important to very important. The issues appears to have some degree of importance for only 49 percent of the population. Forty percent said that it was not of any importance with the remainder either not knowing or not

responding. Thus for the general public fluoridation is not a significant issue.

Finally, when asked if there were other areas of dental health that they would like information about, the majority responded negatively. A small percentage requested information on the effects of sugar and sugary drinks and effective care for teeth and gums. Dental health does not seem to be a high priority amongst citizens and yet poor dental health has far reaching social and economic effects. Education on improving and maintaining dental health should be fostered.

This research confirms that the New Zealand public wish to be involved in decisions regarding fluoridation of their water supplies and that the decision on the issue should be made by either health professionals or the citizens themselves. If this is to be achieved in New Zealand, education is required to empower the community to request it to be implemented, especially among those who stand to benefit most; also to give the public the confidence to make judgements on the topic. This research showed that the issue of fluoridation has some degree of importance for just under half of the population. There was a lack of knowledge on the issue, particularly amongst the younger age group and the non-European ethnic groups. Although the majority of respondents believed there were health benefits from fluoridated water a high proportion of Pacific and Asian and others had little knowledge about fluoride benefits. Of those who believed there were hazards, few had knowledge of what they might be. Currently, the respondents said they would go to the council, the water supply authority, the doctor or the dentist for information. Ideally many would like information from the doctor, the dentist the council or the water supply authority many expressing a preference for information in pamphlet form.

## 6.7 Post Script

### **Development of the issues concerning the fluoridation of the Onehunga Water supply**

- Recently, the Auckland City Council was approached by members of the Community of Onehunga asking council to consider adding fluoride to the local water supply
- In July 2000 the Auckland Health Care/Massey University survey was conducted to find out the current attitudes and knowledge and beliefs of the citizens of Onehunga on the issue of water fluoridation
- In December 2000 the Auckland City Council conducted a resident's preference survey in the Onehunga water supply area
- On February 12, 2001 A report of the survey results were presented to the Mangakieke Community board. ( See Tables 6.3 and 6.4) The board considered all aspects and both the Auckland City Council preference survey and the Auckland Healthcare/Massey University random telephone survey. The board voted 5 to 2 in favour of fluoridation of their public water supply. The motion was then put that the board was to recommend this course of action to the meeting of the Auckland City Works committee
- On February 22, 2001 the Minister of Health, Annette King wrote to the Mayor of Auckland City encouraging her to consider the benefits of fluoridating the Onehunga drinking water supply despite the fact that of those who voted in the preference survey, the majority did not support "this safe and

effective health measure". She reminded the Mayor that she had to have regard to all relevant considerations such as public health and encouraged the Council to consider the recent survey commissioned by the Auckland District Health Board (This Study)

- On March 7, 2001 The Auckland City Council Works Committee met to consider the issues and voted 5 to 2 in favour of fluoridation of the Onehunga water supply area
- On March 22, 2001 The Auckland City Council met to consider the issues and voted 10-9 with one abstention, against fluoridating the Onehunga water supply.

### Nature of surveys

**Survey 1** Auckland Healthcare /Massey University random telephone survey of 282 residents and 50 businesses. This survey was conducted prior to contamination by material from pro and anti fluoridationalists. A summary of results can be found in sections 4 and 5. Table 6.3, below, shows response to Question 4

**Table 6.3** Response to Question 4 of the Onehunga telephone survey.

	Residents	Businesses
In favour of fluoridating Onehunga water supply	48%	47%
Opposed to fluoridation of the water supply	21%	26%
Don't know	30%	27%
No Response	1%	



**Survey 2** Auckland City council commissioned the NBR to conduct a resident's preference survey in the Onehunga water supply area. Personally addressed envelopes containing a covering letter, a one page information sheet containing information favouring fluoridation and one page opposing fluoridation, a voting form and a reply paid envelope were sent to all residents. Results are summarised in Table 6.4

**Table 6.4** Summary of results of the Council preference survey

	Total	Residents	Business
In favour of fluoridating	33%	32%	53%
Opposed to fluoridating	62%	64%	40%
No preference	5%	4%	7%
Total	100%	100%	100%
Base	4741	4424	317

Response rate: 34% from residents, 36% from businesses

Residents were 2:1 opposed to fluoridation, businesses, more than 50% were in favour

### **Survey differences**

The council preference survey differed from the random sample survey in that it endeavored to give every resident the opportunity to have say. It is an undertaking of public consultation rather than a measure of prevailing attitudes

The random sample survey draws a small sample and projects its findings to the population at large.

## **Media /public interaction**

As members of the public became aware of the pending council preference survey letters to "the editor" began appearing in the New Zealand Herald. A long-time anti fluoridationalist, Murray Norman questioned "why fluoride should be added to the water supply for the questionable benefit of a minority of users when the choice of fluoride toothpaste is available?" Another, Robert Anderson, questioned the pressure to "poison our water supplies with NaF" quoting scientists such as Hardy Limeback (Head of Dentistry at the University of Toronto) who claims he no longer supports fluoridation. He claims there is little benefit and much risk and that fluoride adversely affects bones and teeth

Strong endorsement was made on behalf of Auckland Regional Dental from John Dalton (Acting principal dental officer). He reiterates the view that a large body of scientific research shows fluoridation of water supplies at 1ppm to be a safe measure. These letters followed publication of a profluoridation article written by journalist Brian Rudman. He stated that between 1980 and 1994 the average number of missing and filled teeth in form 2 pupils fell from 5.1 to 1.33 with half the country's water supply fluoridated. Decay figures took a turn for the worse rising to 1.53 in 1996 and 1.62 in 1997.

The Minister of Health, Annette King finds these statistics unacceptable and in expressing her concern to 61 mayors stated that nonfluoridation of water supplies was putting the health and well being of young people, in particular, at risk. Her views coincide with the ground swell of parents, teachers and health professionals to have the local water supply fluoridated

In a further article Rudman quotes Dr. Campbell (Auckland Medical Officer of Health) who states that the wide spread use of fluoride toothpaste has seen a dramatic decline in tooth decay, but areas with

fluoridated water show even better results. Dental statistics show that for Maori and Pacific children the benefits of water fluoridation are even higher. In his article Rudman encourages the Auckland City Council to take a lead and get on with fluoridating outstanding areas such as Onehunga.

A summary of the results of this researcher's survey were presented to the Auckland City Works committee and the Auckland Council meeting by Dr Virginia Hope (Medical officer of Health). She pointed out to the councilors that the results of a random survey extrapolated to the whole population, were more likely to give an accurate view of public opinion than the preference survey in which only one third of the population responded. She pointed out the very different results obtained from these two surveys. For example sixty four percent of residents opposed fluoridation in the council's survey compared to twenty one percent in this researchers' random telephone survey. As an observer at the City Council meeting I felt that despite graphic illustrations of the decay seen in teeth of children from nonfluoridated areas and support for fluoridation from the dental profession some councilors rejected fluoridation out of fear and misunderstanding. They did not understand that fluoride was a naturally occurring element found to some degree in all naturally occurring waters, soils, plants and animals, being essential for normal life, health and reproduction. Many believed it to be a "toxin" and therefore should not be imposed on the citizens of Onehunga when other methods of obtaining fluoride such as toothpaste were available to those who wanted it. As councilors are the representatives of the people it appears that a much greater effort is required to educate the population on the nature of the element fluoride, its function and mechanism by which fluoride strengthens teeth. The benefits of fluoridation enjoyed by the majority of Auckland residents, who are on fluoridated water, seemed to be overlooked.

Correspondence relating to the fluoridation issue and council submissions is to be found in Appendix F.

## 7. CONCLUSION

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The aim of this research was to survey a random sample of citizens and businesses of Onehunga, a community served by an unfluoridated water supply. To find out their current knowledge and beliefs on the issue of fluoridation, and where they would go to for information on this subject.

This research showed that there were appreciable gaps in the community's knowledge on fluoridation with important differences showing between ethnic groups and between the younger and older age group. It also found that the residents were more knowledgeable than businesses on this issue. Of the businesses surveyed none were aware that their water supply was spring water.

Older respondents and those ever married were more aware of the issues and had a greater realisation of the reasons for fluoridation than the 18-44 age group, However 60 percent of respondents said that fluoride promoted strong healthy teeth. There was significant distribution of knowledge and attitudes among racial groups with Pacific people, Asians and others differing significantly from Europeans across most issues. Their lack of knowledge was the greatest.

The survey showed the need for education on the issues of oral healthcare and fluoridation. For example, Pacific people whose children might benefit most, have the least knowledge on the topic. The younger age group's knowledge and strength of opinion on fluoridation was significantly less certain than the older age group (45 years and over). A greater percentage of the 18 to 44 age group responded don't know to most questions. This could reflect a lack of recent and current education and debate on the issue. The advertising associated with fluoride tooth paste seems to have made people aware that fluoride strengthens teeth but little recent effort

has been devoted to explaining the benefits of water fluoridation. Further research to find out the current knowledge and opinions of people from fluoridated areas would be useful.

The majority of respondents did believe there were health benefits. The Onehunga survey showed that currently people would expect to get information on fluoride from the Council, the Water Supply Authority, the doctor followed by the dentist. This suggests that the dental health professionals need to take more obvious role in public education on dental health. The respondents would, by preference, like to get their information from the doctor or health professional in person or by pamphlet. The people and places selected as information sources differed significantly amongst racial groups surveyed and this should be taken into account when providing educational information on fluoridation.

This survey showed wide spread ignorance on the issue of water fluoridation and a need for public education, particularly amongst younger age groups and non-European New Zealanders, (the groups which would benefit the most from fluoridation). Despite wide spread ignorance 68 percent of those surveyed wanted a voice, via a referendum, in the decision making process. Therefore there is a need for balanced accessible information rather than "scare tactic" misinformation notices thrust into letterboxes just prior to a referendum.

An ongoing public education campaign on fluoridation should be instigated with a more obvious role in public education being taken by the dental profession. Multi-lingual pamphlets, supplied by water provider organisations or health professionals, should be circulated in conjunction with the promotion of school and pre-school oral care programs concerned not only with diet, dental care, brushing and flossing but the importance of fluoridation. The issue of fluoridation appeared to have some degree of importance for only 49 percent of the population whilst 40 percent said that it was not of any importance.

There is also a need to continue epidemiological surveys to monitor the differences in oral health of communities between fluoridated and non fluoridated water to determine on going value of fluoridation on ageing dentition and to continue the monitoring of detrimental effects caused by excess fluoride.

**The key messages of this research were**

- A belief in the benefits of fluoridation
- Lack of information about fluoridation; especially for Pacific people and Asians and others and to a lesser degree for Maori and Europeans
- More information required particularly on pros and cons of fluoridation
- A greater role taken by the dental profession in public education on oral care
- People want a voice in the decision making process
- A need for balanced education so that people can make an informed choice

## REFERENCE LIST

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1. Achievements in Public Health, 1900-1999; Fluoridation of drinking water to prevent dental caries. *MMWR* 1999; **48**(41): 933-40.
2. American Dental Association, Fluoridation facts March 12<sup>nd</sup>.1999
3. American Dental Association Council on Dental Therapeutics,. New fluoride guidelines proposed. *J Am Dent Association* 1994;**125**: 366
4. Auckland City Council, Progress on health outcome targets,1998
5. Bates, M., Begg, J, Volcanic emissions and the risk to the public health. *NZPHR4* November/ December 1997 ; 81-83
6. Bates, M. Fluoridation of water supplies: an evaluation of the recent epidemiological evidence. Wellington: ESR Ltd. (September, 2000)
7. Birkeland, J.M., Charlton, G. Effect of pH on the fluoride ion activity of plaque. *Caries Res* 1976;**10**:72-80
8. Bohannan, H. A. Symposium on the new fight for fluorides. *Journal of Public Health Dentition* 1985 ; **45**, (3): 133-140
9. Brown, R.H. Fluoride and the prevention of dental caries. Part 1: The role of fluoride in the decline of caries. *New Zealand Dental Journal* **84**:103-108, 1988
10. Brown, L.P., Mulqueen, T. F., Story, E. The effect of fluoride consumption and social class on dental caries in 8 year old children. *Australian Dental Journal* 1990; **35** (1): 61-68



11. Bucher, J.R., Hejtmancik, M.D., Toft, J.D. et al . Results and conclusions of the national toxicology program's rodent carcinogenicity studies with sodium fluoride . *International Journal of Cancer* 1991; 9;**48** (5):733-737.
12. Burt, B.A. and Beltran, E. D. Water fluoridation: a response to critics in Australia and New Zealand. *Journal of Public Health Dentition* 1988; **48**: 214-219
13. .Campbell, D. Personal communications with Peter Dennison, Public Health dentist for Wellington. 1999
14. Campbell, D. A report to the City Works committee, Auckland City Council, 2000.
15. .Campbell, D., Holbrook. L.H., Watson P. Fluoridation: What the public know and what they want. *Australian and New Zealand Journal of Public Health* ,(in press)
16. Chitke, U. and Brand, A. A. Attitudes to water fluoridation in South Africa 1998. Part 1. Analysis by age sex, population and province. *South African Dental Journal* 1999; **54** (11): 537-543
17. Chow, L. C. Tooth bound fluorides and dental caries. *Journal Dental Research* 1990. **69** (special issue): 595-600
18. Clark, D.C., Hann, H.J., Williamson, M.F., Berkowitz, J. Aesthetic concerns of children and parents in relation to different classifications of the tooth surface index of fluorosis in *Dietary Reference Intakes*. 1997, National Academy Press, Washington DC:307
19. Collins, B.S. Fluoridation in New Zealand. Tauranga, New Zealand: NZ Pure water association, 1980.

20. Colquhoun, J. Child dental health differences in New Zealand. *Community Health Studies* 1987a; **11**: 85-90
21. Colquhoun, J. Fluorides and the decline of tooth decay in New Zealand. *Fluoride*. 1993(g); **26**:125-124
22. Cutress, T. W., Coote, G. E., SHU, M., et al. Fluoride content of enamel and dentine of human premolars prior to and following the introduction of fluoridation in New Zealand. *Caries Research* 1996
23. Cutress, T.W., Hunter, P.B.V. Past, present and future trends in the dental health system in New Zealand. *New Zealand Dental Journal* 1991; **88** :2-9.
24. Dalton, J. *Personal communications with D Campbell*,2000.
25. Dawes, C. Fluorides : Mechanisms of action and recommendations for use. *Journal of Canturbury Denal t Association*. 1989. **55**: 721-723
26. Dean, H.T. The investigation of physiological effects by the epidemiological method. In: Moulton, F.R. ed *Fluorine and Dental Health*. Washington , DC: American association for the Advancement of Science. 1942: 23-31
27. Dean, H.T.1942 The investigation of physiological effects by the epidemiological method. In *Dietary Reference Intakes*. National Academy Press 1997: 299
28. Delvin, N. J. The dimensions of dentistry: how much do New Zealanders spend on dental care? *New Zealand Dental Journal* 1987; **83**: 66-71

29. Department of Health and Social Security. Report on health and social security 18: Artificial feeds for the young infant . London: Department of Health and Social security , 1980.
  
30. De Liefde, B. and Herbison, G.B. The prevalence of developmental defects of enamel and dental caries in New Zealand children receiving differing fluoride supplementation in 1982 and 1985. *New Zealand Dental Journal* 1989 **85**: 2-8
  
31. Department of Health. Area health board summary sheets on dental health status. Unpublished , 1990
  
32. Diesendorf, M. Is there a scientific basis for fluoridation? *Community Health Studies* 1980; **4**: 224-230
  
33. Doessel, D.P, 1979 Cost-benefit Analysis and Water Fluoridation; an Australian study. Canberra: The Australian National University, in *Water fluoridation in New Zealand* , Public Health Commission, 1994
  
34. Durie, M.H. Whairoa: Maori Health Development. Auckland, New Zealand: Oxford University Press, 1994.
  
35. Easley, M.W. The new anti fluoridationalists: Who are they and how do they operate? *Journal of Public Health Dentistry* 1985 ;**45** (3) :133-140
  
36. Eble, D.M., Deaton, T.G., Wilson, F. C., Bowden, J.W. Fluoride concentrations in human and rat bone .*Journal Public Health Dentition* 1992; **52**:288-291
  
37. Estada, S., Vuori, E., Helle, A. Effect of maternal fluoride intake on the breast milk fluorine content. *British Journal of Nutrition*, 1982; **48**: 201-204

38. Ekstrand, J. and Ehrnebo, M. Absorption of fluoride from fluoride dentrifices. *Caries Research* 1979;**14**: 96-102.
39. Featherstone, D.J. Prevention and reversal of dental caries: role of low level fluoride. *Community Oral Epidemiology* 1999; **27**: 31-40 in *The cost effectiveness of fluoridating water supplies in New Zealand* 1999.
40. Fejerskov, O., Thylstrup, A., Larsen, M.J. Clinical and structural features and possible pathogenic mechanisms of dental fluorosis. *Journal of Research* 1977; **85**:510-534
41. Fluoride in Oral Health. Public Health Commission, Wellington. 1995:29
42. Frazier, P.J. Fluoridation. A review of social research. *Journal of Public Health Dentition* 1980 Summer; **40**: 214-233
43. Frazier, P.J. Fluoridation history. What we have learned about constituency building? *Journal of Public Health Dentition* 1985 Fall; **43**: 306-312
44. Frenzi, S.C. and Gaylor, D.W. International trends in the incidence of bone cancer are not related to drinking water fluoridation. *Cancer* 1992 ;**70** (3): 611-618.
45. Gray, M.M., Davies-Slowik, J. Community fluoridation –are there benefits? *British Dental Journal* 2001; **190**:30-32
46. Groenveld, A., Van Eck, A.A.M. J., Backer Dirks, O. Fluoride in caries prevention: Is the effect pre or post eruptive. *Journal of Dental Research*. 1990; **69**: 751-755.
47. Guha-Chowdhury, N. Factors influencing caries activity in children: A longitudinal study. Ph.D. thesis, Dunedin: University of Otago, 1992

48. Guy, W.S. Inorganic and organic fluoride in human blood. In *Dietary Reference Intakes* 1997. National Academy Press, Washington D.C.p289
49. Hamilton, I.R. Effects of fluoride on enzymatic regulation of bacterial carbohydrate metabolism. *Caries Research* 1977;**11**(Suppl.1):262-291
50. Hargraves, J.A., Ingam,G.S., Wagg, B.J. Excretion studies on the ingestion of monofluorophosphate toothpaste by children. *Caries Res.* 1970;**4**:256-268
51. Hastings, G.B., Hughes, K., Lowery, S.J. The role of the public in water fluoridation : public health champions or anti-fluoridation freedom fighters? *British Dental Journal* 1998;**184** (1): 39-41.
52. Hillier, S., Cooper, C., Kellingray, S., Russell, G., Huges, H., Coggon, D. I. Fluoride in drinking water and risk of hip fracture in UK. Case control study. *Lancet* 2000;**355**:265-269
53. Hodge, H.C. 1979 The safety of fluoride tablets or drops in *Fluoride in Dentistry* 2<sup>nd</sup> edition. Eds O Fejerskov, J Ekstrand and B Burt. Munksgaard, Copenhagen 1996; 155
54. Horowitz, H.S. The future of water fluoridation and other systemic fluorides *Journal of Dental Research* 1990;**69** (Special Issue): 760-764
55. Hunter, P.B.V., Kirk, R., de Liefde, B. The study of oral health outcomes.: Health Research Services, Department of Health, Wellington 1992.
56. Jacobson, N. J. Goldberg, J. Cooper, C., Lockwood, S.A. The association between water fluoridation and hip fracture among white

women and men aged 65years and older. A natural ecological study.  
*Ann Epidemiology* 1992; **2**:617-626

57. Jones, C.M., Worthington, H. Water fluoridation, poverty and tooth decay in 12 –year-old children. *Journal of Dentistry*, 2000; **28** (6): 389 - 393
58. Jowsey, J., Riggs, B.I., Kelly, P.J., Hoffman, D.L. Effects of combined therapy with sodium Fluoride, vitamin D and calcium in osteoporosis. *American Journal of Medicine*. 1972; **53**:43-49
59. Kaminsky et al, 1990 in Ripa, L.W. A half-century of community water fluoridation in the United States: review and commentary. *J Public Dent*.1993;**53** (1): 17-44.
60. Kleerekoper, M., Menlovic, D. B. Sodiun fluoride therapy of postmenopausal osteoporosis *Endocrinology review* 1993; **14**: 312-323.
61. Krishnamachari, KAVR (1987): In Linder, M.C. ed: Nutritional Biochemistry and Metabolism (2<sup>nd</sup> ed) Appleton and Lange. 1991 Connecticut. 242.
62. Krishnamachari 1990: In Linder, M.C. ed : Nutritional Biochemistry and Metabolism (2<sup>nd</sup> ed) Appleton and Lange 1991 Connecticut
63. Larsen, M.J., Senderovitz, F., Kirkgaard, E., et al. Dental fluorosis in the primary and permanent dentition in fluoridated areas with consumption of either powdered milk or natural cows milk. *Journal of Dental Research* 1988; **67**: 822-825
64. Levallois, P., Grondin, J., Gringras, S. Knowledge, perception and behavior of the general public concerning the addition of fluoride in drinking water. *Canadian Journal of Public Health* 1998; 162-165

65. Leverett, D. Marquis, R.E. Antimicrobial actions of fluoride for oral bacteria. *Canadian Journal Microbial* 1995; **41**: 955-964
66. Leverett, D.H., Adair, S.M., Vaughan, B.W et al. Randomised clinical trial of the effect of prenatal fluoride supplements in preventing dental caries. *Caries Research*.1997; **31**: 174-179
67. Lowery, J.R.J., Thompson, B., Lennon, M.A. How much do the general public want to be involved in decisions on implementing water fluoridation? *British Dental Journal* 2000; **188**(9): 500-529
68. Lowery, R.J. What the papers say: How does the United Kingdom press treat water fluoridation and does it matter? *British Dental Journal* 2000; **189** (1): 14-18.
69. Marthaler, T.M.1983 Practical aspects of salt fluoridation. In *Fluorides in caries prevention*. (eds. J.J.Murray, A.J. Rugg-Gunn, and G.N. Jenkins)3<sup>rd</sup> edition. Butterworth-Heinemann Ltd, University Press Cambridge.1991: 100-109
70. Margolis, H.C., Moreno, E.C. Physiochemical perspectives on the cariostatic mechanisms of systemic and topical fluorides. *Journal Dent Research*.1990; **69** ( special issue): 595-600
71. Marquis, R.E. Diminished acid tolerance of plaque bacteria caused by fluoride .*Journal of Dental Research*. **1990**; **69**: 672-675
72. McDonagh, M.S., Whiting, P.F., Wilson, P.M., Sutton, A.J., Chestnutt, I., Cooper, J., Misso, K., Bradley, B., Treasure, E., Kleijnen, J. Systematic review of water fluoridation. *Br Medical Journal* 2000 ;**321**:855-859

73. Mellanby, M. The role of nutrition as a factor in resistance to dental caries. *Br Dental Journal*, 1937; **62**: 341-352
74. Mertz, W. *J Am Diet Assoc.* 1980; **77**:258-263
75. Millar, D.S. Prevalence of nutritional problems in the world. *Proc. Nutrition. Society.*, 1979; **38**: 197-205
76. Ministry of Health, NZ food: NZ People. Key results of the 1997 National Nutrition Survey. Produced by LINZ Activity and Health Research Unit. University of Otago for the Ministry of Health. 1999.
77. Mormann, J.E. and Muhlemann, H.R. Oral starch degradation and its influence on acid production in human dental plaque. *Caries Research.* 1981; **15**:166-175
78. Murray, J.J., Rugg-Gunn, A.J., Jenkins, G.M. Fluorides and caries prevention. Butterworth. Heinemann, Oxford 1991.
79. Murray, J.J., Rugg-Gunn, A.J.: Fluorides and Dental Caries. 2<sup>nd</sup> Ed. John Wright & Sons, Bristol, England, 1982.
80. National Drinking-Water Standards review expert working Group. Drinking Water Standards for New Zealand 1995.: Ministry of Health, Wellington: 1995.
81. National Research Council. Health effects of ingested fluoride: National Academy Press, Washington DC:1993
82. Neohiko Inone, *Culture of Food and Oral Health in Maori.* Therapeia Publishing Co, Tokyo: 1993
83. Newbrun, E. The effectiveness of water fluoridation *Journal Public Health Dent* 1989; **49**(5): 279-289



84. Nutrition Taskforce. Food for Health. Department of Health, Wellington 1991.
85. O'Neill, H.W. Opinion study comparing attitudes about dental health. *Journal of American Dental Association* 1984; **109** (6): 910-915
86. Patterson, J.T. The dread disease: cancer and modern American culture. Harvard University Press, Cambridge, Massachusetts:1987
87. Pendrys, D.G. Risk of enamel fluorosis in non fluoridated and optimally fluoridated populations : considerations for the dental profession. *Journal of American Dental Assoc*, 2000; **131** (6):746-755
88. Phipps, K.R., Orwoll, E.S., Mason, J.D. Cauley, J.A. Community water fluoridation, bone mineral density and fractures: prospective study of effects in older women. *British Medical Journal* 2000; **321**:860-863.
89. Progress on Health Outcome Targets. NZ: Ministry of Health, Wellington, New Zealand 1998
90. Public Health Commission. Analysis of Submissions to the Public Health Commission on the Draft Policy Statement: Fluoridation of Water supplies.: Public Health Commission, Wellington;1993 (b)
91. Public Health Commission. Water fluoridation in New Zealand: An analysis and monitoring report.: Public Health Commission, Wellington;.1994
92. Public Health Commission Water Fluoridation in New Zealand. Public Health Commission, Wellington; 1994 (b)
93. Public Health Commission. Fluoride and Oral Health: The Public Health Commission's advice to the Minister of Health,Wellington;1995

94. Riggs, D.L., Hodgson, S.F., O'Fallon, W.M. Effects of fluoride treatment on the fracture rate in postmenopausal women with osteoporosis. *New England Journal of Medicine*. 1990; **322**: 802-809.
95. Riley, J.C., Lennon, M.A., Elwood, R.P. The effect of water fluoridation and social inequalities on dental caries in five year old children. *Journal of Epidemiology* 1999; **186** (8):379-400.
96. Riordon, P.J. Perceptions of dental fluorosis. *Journal of Dental Research* 1993; **72**: 1268-1274
97. Ripa L.W. A half-century of community water fluoridation in the United States: review and commentary. *Journal of Public Health Dentistry* 1993;**53**:17-44
98. Roberts-Thomson, K.F., Spencer, A.J. Public knowledge of the prevention of dental decay and gum disease. *Australian. Dental Journal*.1999; **44** (4): 253-258
99. Rojas Sanchez, F., Kelley, S.A., Drake, K.M., Eckert,G.J., Stookey, G.K., Dunipace, A.J. Fluoride intake from foods, beverages and dentrifice by young children in communities with negligibly and optimally fluoridated water : a pilot study. *Community Oral Epidemiology* 1999; **27**(4): 288-297
100. Rugg-Gunn, A.J. Dental caries-the role of dietary sugars In *Nutrition and Dental health* Oxford University Press, New York. 1993:117, 239-253
101. Sakae, T., Hirai, G. Calcification and crystallisation in bovine enamel. *Journal of Dental. Research* 1982; **61**: 57-59

102. Samels, A. Fluoridation: A lawyer looks at the issues (editorial). *Medicine , Science and the Law* 1993;**33**: 185-187
103. Shaw, J.H., Sweeney, E.A. In Goodhart, R.S., Shils, M.E.,eds: *Modern Nutrition in Health and Disease* (6<sup>th</sup> ed). Lea and Febiger, Philadelphia; 1980: 855.
104. Shils, M.E., Olson, J.A., Shike, M. *Modern Nutrition in Health and Disease*. 8<sup>th</sup> edition. Lea and Febiger Baltimore, 1994: 1018.
105. Spak, C.J., Ekstrand, J. and Zyberstein, D. Bioavailability of fluoride added to baby formula and milk. 1982. *Caries Research* ; **16**:249- 256
106. . Fejerskov, O.,Ekstrand, J., Burt, B.A. *Fluoride in Dentistry* 2nd edition, Munksgaard, Copenhagen;1996:43
107. Specker, B.L., Beck, A., Kalkwarf, H., Ho, M. Randomised trial of varying mineral intake on total body bone mineral accretion during the first year of life. *Journal of Pediatrics* 1997; **99**: 12
108. Sreebny, I.M. Sugar availability, sugar consumption and dental caries. *Commun. Dent Oral Epidemiol.*1982; **10**:1-7;In *Nutrition and dental health* ed. A.J. Rugg-Gunn. Oxford University Press, New York 1993.
109. Stephen, K.W., Mcall, D.R., Tullis, J.I. Caries prevalence in Northern Scotland before, and 5 years after, water fluoridation . *British Dental Journal* 1987;**163**: 324-326.
110. Taves, D.R. Dietary intake of fluoride ashed (total fluoride) v. unashed (inorganic fluoride) analysis of individual foods. *British Journal of Nutrition* 1983; **49**: 295-301.

111. The New Zealand Health Strategy: *Discussion document*. Ministry of Health, Wellington NZ; 2000
112. Treasure, E.T., Dever, J.G. The prevalence of caries in 5 year old children living in fluoridated and non-fluoridated communities in New Zealand. *New Zealand Dental Journal* ,1992; **88**:9-13
113. ,United States Public Health ( USPHS) 1991, in *Water fluoridation in New Zealand* ;1994: 93
114. Walters, C.B., Sherlock, J.C., Evans, W.H., and Read, I. Dietary intake of fluoride in the United Kingdom and the fluoride content of some food stuffs. *Journal of Science. Food and Agriculture*. 1983; **34**:523-528
115. Wei, S.H.Y. and Yui, C.K.Y. Evaluation of the use of topical fluoride gel. *Caries Research* 1993;**27**, (1): 29-34.
116. WHO. Fluorides and oral health: WHO *Technical Report Series* 846 World Health Organisation, Geneva;1994.
117. WHO *Community Dental Health* 1996: **13**, (2): 3-4
118. Wright, J.C., Bates, M.C., Cutress, T., Lee, M. The cost-effectiveness of fluoridating water supplies in New Zealand *Epidemiological Group ESR*, Porirua , New Zealand;1999.
119. Whitford, G.M.1996 The metabolism and toxicity of fluoride. In *Dietary Reference Intakes for calcium, phosphorus, magnesium, vitamin D and fluoride* National Academy Press Washington, D.C.1997
120. York Study, Fluoridation of drinking water: a systematic review of its efficacy and safety *NHS Centre for reviews and Dissemination*, University of York, York; 2000

# APPENDIX A

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Fluoride sampling frame

# APPENDIX A

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## FLUORIDE SAMPLING FRAME

### Population of Onehunga Water zone

c 18723 persons aged 18 years and over

**Sample** 300 persons aged 18 years and over  
100 business

### Stratification:

#### Gender

- 29% male aged 18-44 90 persons
- 17% male aged 45 and over 50 persons
- 31% female aged 18-44 90 persons
- 23% female aged 45 and over 70 persons

#### Ethnicity

- 59% European 180 persons
- 11% Maori 30 persons
- 19% Pacific people 60 persons
- 10% Asian 30 persons

#### Marital Status

- 16% never married 50 persons
- 84% ever married 250

Consent application

Ethics Committee response

Additional information for Ethics Committee

Ethics committee approval of application

---

**APPLICATION FOR APPROVAL OF PROPOSED TEACHING/RESEARCH  
PROCEDURES INVOLVING HUMAN SUBJECTS**

---

**APPLICANT(S):** Name: Patsy Watson.....

Department: Institute of Food Nutrition and Human Health, Albany Campus .....

Contact Email/Number: p.watson@massey.ac.nz, Phone 9755 .....

Status: Senior lecturer, Programme Leader in Human Nutrition.....  
(e.g. lecturer, PhD/masterate student)

Name of Employer: Massey University .....

**PROJECT:** Title: A random survey of knowledge and opinion about water fluoridation in  
Onehunga homes and businesses.....

Status: Masterate thesis, Student Researcher Lynn Holbrook .....

Funding Source: Auckland Healthcare .....

Clinical Trial Status:                                      yes                                       no \*\*\*

**ATTACHMENTS:** Questionnaires.....  
(e.g. Information Sheet(s), Consent Form(s), Questionnaire, etc)

**SUPERVISOR(S):** Name: Patsy Watson,  
Dr Donald Campbell.....

Department: Institute of Food Nutrition and Human Health, Albany Campus  
Public Health Protection, Auckland Healthcare .....

**SIGNATURE(S):** Applicant(s): Patsy Watson.....

Supervisor(s): Patsy Watson.....  
(required for all projects involving student research, implies satisfaction with application)

**DATE:**                                      16/5/00.....

---

**OFFICE USE ONLY**

Received:

Decision:



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**APPLICATION FOR APPROVAL OF PROPOSED TEACHING/RESEARCH  
PROCEDURES INVOLVING HUMAN SUBJECTS**

---

**APPLICANT(S):** Name: Patsy Watson .....

Department: Institute of Food Nutrition and Human Health, Albany Campus .....

Contact Email/Number: p.watson@massey.ac.nz, Phone 9755.....

Status: Senior lecturer, Programme Leader in Human Nutrition .....

(e.g. lecturer, PhD/masterate student)

Name of Employer: Massey University .....

**PROJECT:** Title: A random survey of knowledge and opinion about water flouridation in  
Onehunga homes and businesses .....

Status: Masterate thesis, Student Researcher Lyn Holbrook .....

(e.g. staff research, doctorate/masterate)

Funding Source: Auckland Healthcare .....

Clinical Trial Status:                                   yes                                    no \*\*\*

**ATTACHMENTS:** Questionnaires .....

(e.g. Information Sheet(s), Consent Form(s), Questionnaire, etc)

**SUPERVISOR(S):** Name: Patsy Watson,  
Dr Donald Campbell .....

Department: Institute of Food Nutrition and Human Health, Albany Campus;  
Public Health Protection, Auckland Healthcare .....

**SIGNATURE(S):** Applicant(s): .....

Supervisor(s): Donald Campbell .....

(required for all projects involving student research, implies satisfaction with application)

**DATE:** .....

---

**OFFICE USE ONLY**

**Received:**

**Decision:**

# APPLICATION CONTENT

## 1. DESCRIPTION

### 1.1. Justification

At present the Onehunga water supply zone is the only one within the Auckland City which is non-fluoridated as it has a unique supply from the Onehunga springs. (Natural level 0.12mg/L compared with a target of 0.7-1.0 mg/L). Onehunga Borough has refused requests to fluoridate in the past but an application from some residents has been forwarded to Auckland City Council by the community board. The Ministry of Health "health outcome" target for fluoride is to increase the proportion of the population on reticulated water supply with fluoridated water from 56% in 1998 to 70% in the year 2000. The justification for this being that the Ministry of Health has a large body of scientific material from peer reviewed journals to show that there is overwhelming evidence for the effectiveness and safety of water fluoridation, and further direct evidence from school dental service data that it improves the oral health status of New Zealand children. As part of its oral health care programme, Auckland Healthcare is looking to influence consumers, who are not on fluoridated water, as to its benefits and safety. The justification of this study is to survey the current knowledge, attitudes and beliefs of citizens and businesses about fluoride, and to find out from whom and from where respondents expect to find key sources of knowledge. This information will be used to target the most useful services for disseminating knowledge on water fluoridation.

### 1.2 Objectives

- To survey by telephone a representative sample of 300 citizens of the Onehunga Borough aged 18 years and over on their current attitudes and beliefs on fluoridation.
- To survey by telephone 100 businesses in the area to find out if fluoridation is an important issue in their business operation
- To find from where and from whom the residents and businesses expect to find key knowledge on the issue of water fluoridation.

### 1.3. Procedures for Recruiting Participants and Obtaining Informed Consent

Participants will be adults aged 18 years and over, either representative of a household, or a business. A commercial telemarketing firm will conduct this survey, under contract to Auckland Healthcare, on a random sample of Onehunga residents and businesses. The survey will be conducted in line with the usual consent and ethical procedures telemarketing firms operate under. Around 300 households and 100 businesses will be sampled. If any person or business representative selected from a random start point address does not wish to answer the questionnaire, the telemarketer will move to the next allocated address, according to the random selection procedure adopted by the firm. The sampling frame is attached as Appendix 1.

#### **1.4. Procedure in which Research Participants will be involved**

The participants will only be required to provide their name, address, age group, sex, marital status, and ethnic group to the telemarketer and answer the appropriate ten-minute questionnaire on behalf of either a household or business. They will not be required to submit to any measurement or sample collection. The names and addresses of the participants will be kept by the telemarketing firm for their random quality control checks that the interview did in fact take place. This information will not be passed on to Auckland Healthcare or Massey University/

#### **1.5. Procedures for handling information and material produced in the course of the research including raw data and final research report(s)**

The information will be collected as hard copy: no audio or video records will be used.

All participants will be given a code number. A separate master file will be kept by the telemarketing company linking subject address and phone number to code number. The supervisors and researcher will have access to this list if necessary. All data entered in the computer will be identified by code number only. Electronic data will be stored on the researcher's hard drive or personal H: drive on the network and will be accessed by password only, by the researcher or her supervisors. The password will be changed regularly to maintain security. All completed data collection forms will be stored in locked filing cabinets in the nutrition research room, which is locked and alarmed when no researcher is present.

No subject will be identified by address or code number in the final research report, or in any conference presentations or scientific papers that may result from this work.

## **2. ETHICAL CONCERNS**

### **2.1. Access to Participants**

The participants will be accessed using the standard random selection procedure employed by the telemarketing firm selected. The telemarketing firm will be supplied with the geographical boundaries and then will have to recruit randomly per the frame. The sampling frame is attached in Appendix 1.

### **2.2. Informed Consent**

All selected participants are clearly given to understand by the telephone interviewer, before the interview commences, that they have the right to refuse to take part in the telephone interview.

### **2.3. Anonymity and Confidentiality**

The measures taken in 1.5 will be used to ensure the anonymity and confidentiality of the volunteers.

## **2.4. Potential Harm to Participants**

There is no possible harm that can befall the volunteers for this study. All volunteers have the right to decline to answer any question they feel uneasy about.

## **2.5. Potential Harm to Researcher(s)**

The study methodology involves no possible harm to the researcher. She has no direct contact with any of the participants, and will deal only with the hard copy results of the questionnaire.

## **2.6. Potential Harm to the University**

The study can bring no potential harm to the University. The strict anonymity, confidentiality and professional attitude during data collection and handling of the data should avoid any potential embarrassment to the University.

## **2.7. Participant's Right to Decline to Take Part**

Before the telephone interview begins the potential participant is clearly told that they can refuse to take part in the survey without prejudice, or can refuse to answer any question they are not comfortable with.

## **2.8. Uses of the Information**

The information obtained from the study will be analyzed and written up as a research report and thesis, presented as a conference paper or poster, and if suitable written up as a paper for publication in a scientific journal.

## **2.9. Conflict of Interest/Conflict of Roles**

The study involves no conflict of interest for either the researcher or the supervisors.

## **2.10. Other Ethical Concerns**

It would be most unlikely that any serious social or family problem will be revealed during this very short and impersonal interview by a telemarketing company.

# **3. LEGAL CONCERNS**

## **3.1. Legislation**

### **3.1.1. Intellectual Property legislation E.g. Copyright Act 1994**

All scientific material will be appropriately referenced. The data collected will belong to Auckland Healthcare, with right of access, usage and joint publication granted to the Massey University supervisor and the student.

**3.1.2. Human Rights Act 1993**

The questions in this study are not personal and contain no insulting or derogatory remarks directed at any person or section of the community.

**3.1.3. Privacy Act 1993**

The information required will be collected directly from the volunteer, and recorded as hard copy. No video or audio records will be used. Measures to ensure confidentiality for volunteers are detailed in Section 1.5.

**3.1.4. Health and Safety in Employment Act 1992**

A telephone survey involves no possible health hazards.

**3.1.5. Accident Rehabilitation Compensation Insurance Act 1992**

The researcher will be covered by ACC when travelling in her car to discussions with her supervisors.

**3.1.6. Employment Contracts Act 1991**

Not applicable

**3.2. Other Legal Issues**

Not applicable

**4. CULTURAL CONCERNS**

The telemarketers are well used to dealing with all ethnic groups in a sensitive and appropriate manner. The questions themselves do not have an ethnic component.

**5. OTHER ETHICAL BODIES RELEVANT TO THIS RESEARCH**

**5.1. Ethics Committees**

Auckland Ethics Committee

*Note: List other ethic committees to which you are referring this application.*

**5.2. Professional Codes**

Not Applicable

*Note: List all New Zealand professional codes to which this research is subject.*

**6. OTHER RELEVANT ISSUES**

*Note: List any other issues you would like to discuss with the MUHEC.*

None that we perceive at this time.

# APPENDICES

## APPENDIX 1

### FLUORIDE SAMPLING FRAME

**Population of Onehunga Water Zone** c18723 persons aged 18 years and over

**Sample** 300 persons aged 18 years and over  
100 businesses

#### **Stratification:**

- Sex
  - 29% male aged 18-44 90 persons
  - 17% male aged 45 and over 50 persons
  - 31% female aged 18-44 90 persons
  - 23% female aged 45 and over 70 persons
- Race
  - 59% European 180 persons
  - 11% Maori 30 persons
  - 19% Pacific Islanders 60 persons
  - 10% Asian 30 persons
- Marital
  - 16% never married 50 persons
  - 84% ever married 250 persons

## APPENDIX 2

### PERSONAL QUESTIONNAIRE

1. Do you know anything about fluoride?

Yes  
No

2. Do you use fluoride toothpaste?

Yes  
No  
Don't know

3. Most areas in Auckland have fluoridated water. Do you know the reason for this?

Yes  
No  
Don't know

3b If “yes”, please state briefly what you think the reasons are?

4. Is the water supply to your home fluoridated?

- Yes
- No
- Don't know

5. Would you be in favour of fluoridation of the water in your area?

- Yes
- No
- Don't know

6. What is the reason for your answer?

7. Do you think there are any health benefits from adding fluoride to the water?

- Yes
- No
- Don't know

7b. If you answered “yes” please state what you think the benefits are.

8. Do you think there are any health hazards from adding fluoride to the drinking water?

- Yes
- No
- Don't know

8b If “yes” please state what you think these hazards are.

9. If you had to decide whether your water supply was to be fluoridated or not

a. From whom would you expect to get your information from?

- Friends
- Family
- Dentist
- Chemist
- Doctor
- Medical officer of health
- Water supply authority
- The council
- Media
- Other (please state)

b. From where would you expect to get your information from?

Health shop  
Medical centre  
Library  
Internet  
Other

10. If you were seeking information, what sort of information would you like?

11. Who do you think should make the decision as to whether or not fluoride should be added to your local water supply?

The Government  
City councils  
Health authorities  
Citizens of the area  
Other (please state)

12. Are you happy that the Auckland City Council makes the final decision on whether or not the water in your area is fluoridated?

Yes  
No  
Don't know

13. Should there be a local referendum on this issue?

Yes  
No  
Don't know

14. How important to you is the issue of water fluoridation?

Not important  
Important  
Very important



## APPENDIX 3

### BUSINESS QUESTIONNAIRE

1. Do you know anything about fluoride?

Yes  
No

2. What sort of water supply do you use for your business?

Private spring  
Reticulated  
Don't know

(If your business uses private spring water go to question 2b)

2b. What are your reasons for using private spring water?

Economic  
Water purity  
Other (explain)

3. Most areas in Auckland have fluoridated water. Do you know the reason for this?

Yes  
No

3b. If "yes" please state briefly what you think the reasons are.

4. Is the water supply coming to your business premises is fluoridated?

Yes  
No  
Don't know

5. Would you be in favour of the fluoridation of the water supply to your business?

Yes  
No  
Don't know

6. What is the reason for your answer?

7. Do you think that there are any health benefits from adding fluoride to water?

- Yes
- No
- Don't know

7b. If you answered "yes" please state what you think the benefits are.

8. Do you think that there are any health hazards from adding fluoride to drinking water?

- Yes
- No
- Don't know

8b. If "Yes" please state what you think these hazards are.

9. If you had to decide on whether your water supply was to be fluoridated or not:

a. From whom would you expect would you expect to get your information from?

- Friends
- Family
- Dentist
- Chemist
- Doctor
- Medical office of health
- Water supply authority
- The council
- The Media
- Other

b. From where would you expect to get your information?

- Health shop
- Medical centre
- Library
- Internet
- Other (please state)

10. If you were seeking information, what sort of information would you like?

11. Who do you think should make the decision as to whether or not fluoride should be added to your local water supply?

The Government  
City councils  
Health authorities  
Citizens of the area  
Other (please state)

12. Are you happy that The Auckland City Council makes the final decision on whether or not the water in your area is fluoridated?

Yes  
No  
Don't know

13. Should there be a local referendum on this issue?

Yes  
No  
Don't know

14. How important to you is the issue of water fluoridation?

Not important  
Important  
Very important

6 June 2000

Lynn Holbrook/Patsy Watson  
C/O Inst. Food, Nutrition & Human Health  
Massey University  
ALBANY

Dear Lynn/Patsy

**HUMAN ETHICS APPROVAL APPLICATION – MUAHEC 00/041  
A RANDOM SURVEY OF KNOWLEDGE AND OPINION ABOUT WATER FLUORIDATION  
IN ONEHUNGA HOMES AND BUSINESSES**

Thank you for the above application, which was received and considered by the Massey University, Albany Campus, Human Ethics Committee at their meeting held on 25th May 2000. The Committee raised the following points regarding your application:

- Please provide a copy of the introduction statement to be used by interviewers to the Committee Secretary.
- Please clarify the relationship of the student to the research company and to Auckland Healthcare. This needs to be made clear to participants.
- 1.4 - Please clarify the privacy of participants' information in relation to the telemarketing company, i.e. that the information will not be used for any other purposes, what will happen to this information at the conclusion of the research, etc.

Subject to the above amendments and inclusions being received by the Committee Secretary, and accepted by the Chairperson, the ethics of the application will be approved in writing.

Any departure from the approved application will require the researcher to return this project to the Human Ethics Committee, Albany Campus, for further consideration and approval.

Yours sincerely



*mp*  
Dr Mike O'Brien  
**CHAIRPERSON,  
MASSEY UNIVERSITY, ALBANY CAMPUS  
HUMAN ETHICS COMMITTEE**

cc. Mrs Patsy Watson, Inst. Food, Nutrition & Human Health, Massey University, Albany

## **HUMAN ETHICS APPROVAL APPLICATION - MUAHEC 00/041**

### **A RANDOM SURVEY OF KNOWLEDGE AND OPINION ABOUT WATER FLUORIDATION IN ONEHUNGA HOMES AND BUSINESSES**

#### **REPLY TO THE POINTS RAISED BY THE COMMITTEE IN THE LETTER DATED 6/6/00**

##### **1. Introduction statement**

The introductory statements used by the teleinterviewers follow.

- **For households**

'I am ringing in connection with a study being conducted by Auckland Healthcare and a research student from Massey University, Albany Campus about Fluoride. Are you able to participate in our study by answering a few questions? It will only take a few minutes. Are you 18 years of age or older?'

If 'yes' to both these questions the interview commences.

- **For businesses**

'I am ringing businesses in the Onehunga area in connection with a study being conducted by Auckland Healthcare and a research student from Massey University, Albany Campus about water fluoridation. Are you able to participate in our study by answering a few questions? It will only take a few minutes.'

If 'yes' to this question the interview commences.

**Note: We do not want to say the student is a nutrition student or comes from the Institute of Food Nutrition and Human Health as this may bias the response.**

##### **2. Relationship of the student to the research company and Auckland Healthcare**

The research company that carries out the telesurvey has been hired by Auckland Healthcare, but liases directly with the student. The student prepared, designed and piloted questionnaires will be formatted and printed by Auckland Healthcare and filled in as hard copy by the teleinterviewers. The telephone interviews will be completed in about 3 weeks and returned to the student for analysis.

The project was proposed by Auckland Healthcare. Dr Donald Campbell is second supervisor. Auckland Healthcare meets all study costs. The student receives no personal payment. She liases regularly with both Dr Campbell and her Massey supervisor to discuss progress. When analysis is complete, Auckland healthcare will receive a copy of the survey results.

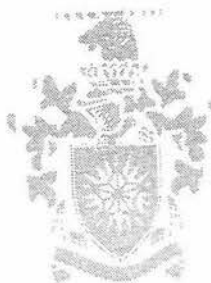
The relationship between the company, Auckland Healthcare and the student is stated in the introduction. See1.

### **3. Clarification of the privacy of the participants information (Refer 1.4 Application)**

Telephone numbers in the area to be surveyed are supplied randomly by Telecom. The questionnaires and a list of phone numbers are given to 4 tele interviewers. The interviewers ring the phone numbers, and if consent is given, demographic details are recorded and the interview completed. Names and addresses are not asked or recorded in any way, and the telephone list is not used for any other survey.

At the end of each day the interview coordinator, will collect the demographic details for each subject from each interviewer, to check the quota received for the Onehunga profile population. When the target is reached for each population sector, e.g. male, European, 45+, no more subjects in that group will be selected. The process continues until all quotas are filled.

The telesurvey firm constructs a unique identifier for each subject by allocating a code number to each randomly selected phone number. Names and addresses are not recorded. At the end of the survey the market research company destroys the unique identifier/phone number/code number masterlist. Thus no subject will be able to be identified once the survey is completed.



**Office of the Principal**  
Massey University  
Albany Campus  
Private Bag 102 904,  
North Shore MSC,  
Auckland,  
New Zealand  
Principal: 64 9 443 9799 ext 9517  
Campus Registrar: 64 9 443 9799  
ext 9516  
Facsimile: 64 9 414 0814

20 June 2000

Lynn Holbrook  
C/O Mrs Patsy Watson  
Inst. Food, Nutrition and Human Health  
Massey University  
Albany

Dear Lynn

**HUMAN ETHICS APPROVAL APPLICATION – MUAHEC 00/041  
A RANDOM SURVEY OF KNOWLEDGE AND OPINION ABOUT WATER FLUORIDATION  
IN ONEHUNGA HOMES AND BUSINESSES**

Thank you for your amended application details, which we recently received and have been placed on our files.

The amendments you have made now meet the requirements of the Massey University, Albany Campus, Human Ethics Committee and the ethics of your application, therefore, are approved.

Yours sincerely



Dr Mike O'Brien  
**CHAIRPERSON,  
MASSEY UNIVERSITY, ALBANY CAMPUS  
HUMAN ETHICS COMMITTEE**

cc. Mrs Patsy Watson, Inst. Food, Nutrition and Human Health, Massey University, Albany

# Appendix C

Personal Questionnaire





**Water Fluoridation  
Study Questionnaire for the Telephone**

<i>Unique Identifier</i>

**Interviewers' dialogue:**

I am ringing in connection with a study being conducted by Auckland Healthcare and an MSc thesis student from Massey University, Albany. The aim is to assess current knowledge and beliefs on the issue of water fluoridation. Are you able to participate in our study by answering a few questions? It will only take a few minutes. (Are you 18 years or over?)

Yes:  *Start interviewing section A- Demographics*

No:

**Section A- Demographic information**

**1. Age:**

- 1. 18-44
- 2. 45 and over

**2. Gender:**

- 1. Male
- 2. Female

**3. Which ethnic group do you belong to?**

- 1. NZ Euro /Pakeha
- 2. NZ Maori
- 3. Pacific Islander
- 4. Asian
- 5. Other (specify)

.....

**4. Marital status:**

- 1. Never married
- 2. Ever married

**5. Do you have or are you the principal caregiver for any children under 12 years of age**

- Yes
- No
- Don't know

Section B: Questionnaire (personal)

**1. Do you use fluoride toothpaste?**

- Yes
- No
- Don't know

**2. Most areas in Auckland have fluoridated water. Do you know the reason for this?**

- Yes
- No

**2b. If "yes" please state briefly what you think the reasons are.**

.....

.....

**3. Is the water supply to your home fluoridated?**

- Yes
- No
- Don't know

**4. Would you be in favour of fluoridation of the water in your area?**

- Yes
- No
- Don't know

**5. Do you think there are any health benefits from adding fluoride to the water in your area?**

- Yes
- No
- Don't know

**5b. If you answered "yes" please state what you think the benefits are.**

.....

.....

**6. Do you think there are any health hazards from adding fluoride to the drinking water?**

- Yes
- No
- Don't know

**6b. If “Yes” please state what you think these hazards are.**

.....  
.....

**7. Currently, where would you go, or whom would you speak to if you had to decide whether your water supply was to be fluoridated.**

*(Tick as many as are appropriate)*

- Friends
- Family
- Dentist
- Chemist
- Doctor
- Medical Officer of Health
- Water Supply Authority
- The Council
- The Media
- Health shop
- Medical Centre
- Library
- Internet
- Other (please state)

**8. If you wanted to know more about water fluoridation, what sort of information would you like? -Probe-e.g. What is it, what does it do, benefits, safety etc.?)**

.....  
.....

**8b. Ideally, who or where would you prefer to get it from?**

*(Interviewer to probe when, where and in what form*

*E.g. doctors surgery, brochure, Internet, with rates notice, 0800 number)*

.....  
.....

**9. Who do you think should make the decision as to whether or not fluoride should be added to your local water supply? (tick as many as are appropriate)**

- |   |   |
|---|---|
| <input type="checkbox"/> The Government       | <input type="checkbox"/> The Citizens of the Area |
| <input type="checkbox"/> City Councils        | <input type="checkbox"/> Health Authorities       |
| <input type="checkbox"/> Other (please state) |   |

**10. Do you think that it is appropriate that the Auckland City Council makes the final decision concerning water fluoridation in your area?**

- Yes
- No
- Don't know

**11. Should there be a local referendum on this issue?**

- Yes
- No
- Don't know

**12. How important to you is the issue of water fluoridation?**

.....  
.....

**13. What do you consider the best way to prevent dental decay?**

*(tick one only)*

- Oral Hygiene
- Dental visits
- Diet
- Fluorides
- Other (Please state)

.....  
.....

**14. If you were receiving information about fluoride are there any other areas of oral / dental health you would like information about?**

*(Such as effects of sugar on teeth, effects of sugary drinks, effectiveness of brushing and toothpaste, gum disease, bad breath etc.)*

*Specify.....*

.....  
.....  
.....  
.....

# **Appendix D**

Business Questionnaire



**Water Fluoridation  
Study Questionnaire for the Telephone**

*Unique Identifier*

**Interviewers' dialogue:**

I am ringing businesses in the Onehunga area in connection with a study being conducted by Auckland Healthcare and an MSc thesis student from Massey University, Albany. The aim is to assess current knowledge and beliefs on the issue of water fluoridation. Are you able to participate in our study by answering a few questions? It will only take a few minutes.

- Yes:  (Start interviewing section B)
- No:  (ask for another appointment /convenient time for interview)

**Section B: Business Questionnaire**

**1. What sort of water supply do you use for your business?**

- Private spring
- Reticulated
- Don't know

*(If your business uses private spring water go to question 1b)*

**1b. What are your reasons for using private spring water?**

- Economic
- Water purity
- Other (explain) .....

.....  
.....

**2. Most areas in Auckland have fluoridated water. Do you know the reason for this?**

- Yes
- No

**2b. If “yes” please state briefly what you think the reasons are.**

.....  
.....  
.....

**3. Is the water supply coming to your business premises fluoridated?**

- Yes
- No
- Don't know

**4. Would you be in favour of the fluoridation of the water supply to your business?**

- Yes
- No
- Don't know

**4b. What is the reason for your answer?**

.....  
.....  
.....

**5. Do you think that there are any health benefits from adding fluoride to water?**

- Yes
- No
- Don't know

**5b. If you answered “yes” please state what you think the benefits are.**

.....  
.....  
.....

**6. Do you think that there are any health hazards from adding fluoride to drinking water?**

- Yes
- No
- Don't know

**6b. If "Yes" please state what you think these hazards are.**

.....

.....

.....

**7. Currently, where would you go, or whom would you speak to if you had to decide whether your water supply was to be fluoridated. (tick as many as are appropriate - )**

- Friends
- Family
- Dentist
- Chemist
- Doctor
- Medical office of health
- Water supply authority
- The Council
- The Media
- Health Shop
- Medical Centre
- Library
- Internet
- Other (please state)

**8. If you wanted to know more about water fluoridation, what sort of information would you like? (probe e.g. what is it , what does it do , benefits , safety, )**

.....

.....

.....



**8b. Ideally, who or where would you prefer to get your information from?** (*Interviewer to probe when, where and in what form e.g. place, brochure, Internet, with rates notice, 0800 number*)

.....

.....

.....

**9. Who do you think should make the decision as to whether or not fluoride should be added to your local water supply?** (*Tick as many as are appropriate*)

- The Government
- City Councils
- Health Authorities
- Citizens of the area
- Other (please state)

**10. Do you think that it is appropriate that the Auckland City Council makes the final decision concerning water fluoridation in your area?**

- Yes
- No
- Don't know

**11. Should there be a local referendum on this issue?**

- Yes
- No
- Don't know

**12. How important to your business is the issue of water fluoridation?**

.....

.....

.....

# Appendix E

Draft paper submitted for publication

# **Fluoridation – what the public know and what they want**

## **Authors**

Donald Campbell, Public Health Protection Auckland Healthcare

Lynette Holbrook, Institute of Food Nutrition and Human Health, Massey University, Albany Campus

Patsy Watson, Institute of Food Nutrition and Human Health, Massey University, Albany Campus

## **Abstract**

### **Objective**

To describe the knowledge and beliefs on fluoridation of a community served by an unfluoridated water supply prior to the population being consulted on possible implementation of fluoridation.

### **Methods**

Telephone survey of a sample of residents and businesses in Onehunga utilising a semi-structured questionnaire. Comparisons were made among responses of ethnic and age groups.

### **Results**

Residents were more conversant concerning fluoridation than business users. There were significant differences of the knowledge and beliefs among ethnic groups. Younger persons and those who had never been married were less knowledgeable. Pamphlets supplied by water-provider organisations or health professionals were the preferred methods of acquiring information on the topic. While the majority of respondents wished to have the opportunity to express their views via a referendum, health authorities were the favoured decision-makers on fluoridation implementation.

### **Conclusions and implications**

Appreciable gaps were identified in this community's knowledge on fluoridation with important differences based on ethnicity and age demonstrated. In developing strategies and information to enable the population to acquire informed opinions on water fluoridation for their community this sub-group difference require to be addressed.

## **Background**

Fluoridation of communal water supplies continues to generate controversy with legislators and local body politicians tending to avoid the issue because of its aura of dispute. It is a battleground for vigorous debate between the majority of the scientific community and outspoken groups who pursue their opposition with fervour. This

despite recent reviews which have demonstrated health and cost-benefit from its use.<sup>1, 2, 3, 4</sup>

Fluoridation of water supplies began in New Zealand in 1954 with an estimated 57% of the population receiving fluoridated supplies by 1999.<sup>4</sup> Government support for fluoridation in New Zealand remains high with the Minister of Health having written recently to local authorities to establish their views. The improvement of oral health is one of the 12 priority population objectives in the draft *New Zealand Health Strategy* with the proportion receiving water fluoridation one of the current targets.<sup>5</sup> The government considers its implementation as an important contributor to its aim of improving the health of sections of society.

How to involve the public in the decision-making process when implementing new water fluoridation schemes is an ongoing issue. Local authorities are responsible for making decisions on fluoridation and funding its implementation. The majority of greater Auckland premises receive fluoridated water. Within Auckland City, following resolutions of the former Onehunga Borough, the homes and businesses (approximately 12,000 connections) supplied from the Onehunga Springs water source receive non-fluoridated water. There have been numerous requests from local residents and interested parties for fluoride to be added to the supply, the most recent in 1999. To aid their decision making in response to this application, Auckland City councillors resolved to canvas the wishes of the Onehunga water users by carrying out a survey of residents and businesses using a General Preference Measure.

Public Health Services in New Zealand are contracted to improve and protect the oral health of children. To fulfil this objective they are expected to advocate for fluoridated water supplies. In anticipation of the Auckland City survey, Public Health Protection Auckland Healthcare, the regional provider of public health services, commissioned a study of the knowledge, attitudes and beliefs on fluoridation of those served by the Onehunga Water Treatment Zone. The findings were sought to enable a public information/advocacy campaign to be instigated to permit users to give informed responses to Auckland City's review of public opinion.

## Methods

Telephone surveys were carried out by a market research company on a sample of residents aged 18 years and over and of businesses served by the Onehunga Water Treatment Zone. From the 1996 Census data sample sizes were determined to enable representation of the Zone population in terms of ethnicity and age group based on a maximum 10% difference with 80% power at the 95% confidence level. Resident participants were recruited by random dialling of the phone numbers falling within the geographical area with race and age quotas based on the required sample sizes. Normal telephone survey practices with respect to dial-backs and times of calling to achieve equal opportunity of participation were observed. Businesses were recruited randomly from a telephone database with the same statistical power parameters.

The study instrument was a questionnaire utilising closed and open questions that had been pre-tested and piloted in another telephone area of Auckland. The resident and

business questionnaires were identical apart from the demographic section. The questions covered respondents' current knowledge and beliefs on fluoridation, where they would seek information on the topic and the method and organisation that should make the final decision. Statistical analysis was performed using Chi-squared Goodness of Fit and Independence tests.

## Results

Two hundred and eighty two residents aged 18 years and over and 50 businesses were interviewed. When the demographics of the residents interviewed were compared against the 1996 Census population, there were statistically significant differences in the gender and ethnicity proportions. A greater proportion of females was questioned and there was a deficit of Pacific People. *Insert Table 1*

Residents were more likely to know if their water supply was fluoridated than business respondents were with most knowing of a relationship to dental health. Though they were less certain of the health benefits, commercial users considered hazards to be less likely. Improving dental health was described as the greatest benefit while no single reason was given for deeming fluoridation to be a hazard. Oral hygiene was considered the best way of stopping tooth decay (64%), compared to dental visits (10%), diet (8%) and fluoride supplements (4%). The residents were significantly less in favour of a referendum and were less in support of the Council making the decision than the commercial users (68% v 82%).

*Insert Table 2*

There were significant differences in the distributions of knowledge and attitudes to fluoridation among ethnic groups. Table 2 New Zealand European and Maori groups did not vary significantly in the areas examined apart from knowing the reasons for fluoride use and favouring use of fluoride. Pacific people and Asians and others differed significantly from Europeans across all issues; Europeans were more definite in their knowledge and opinions while Pacific people responded "Don't know" most frequently.

*Insert Table 3*

The younger age group's knowledge and strength of opinion on fluoridation was significantly less certain than their older counterparts with a greater percentage responding "don't know" to every question. Similarly those who had never been married seemed to be less knowledgeable on the topic than individuals who were or had ever been married. There were no differences between the responses of females and males. Adjusting the responses for either the racial or gender distributions of the Onehunga Census population did not alter the significance of the findings.

*Insert Table 4*

New Zealand European residents and business responders did not differ significantly in favouring fluoridation nor on its health effects. However Europeans were more knowledgeable on whether their supply was fluoridated ( $P \leq 0.01$ ) and the reasons for

this ( $P \leq 0.01$ ). They preferred a referendum ( $P \leq 0.01$ ) and opposed the Council making the decision ( $P \leq 0.05$ ).

The most likely sources that business users would exploit for information on this topic were the water supply authority (47%), the council (29%) and a doctor (9%). Private individuals would go to the council (18%), water supply authority (18%), dentist (13%) and doctor 13%. Neither use of the Internet nor a library exceeded 5% for either group. Most respondents preferred this information to be in pamphlet form. Health authorities (49%) and citizens of the area (31%) were the preferred decision-makers of residents. Citizens (43%) and health authorities (34%) were the favoured choices of business users. A referendum was approved by 183 (65%) of the residents and 43 (15%) considered the council should make the final choice. Only 31 (11%) of those wishing a referendum supported the council being the arbiter.

## Discussion

Telephone surveys have several opportunities for bias. The sampling in this survey was not completely random, being based on ethnic and age group quotas. The allocations were determined utilising the 1996 Census. Onehunga is an area of population mobility so the proportions used may not have characterised the year 2000 inhabitants. All groups may not be equally represented in their possession of a telephone. There may be differences in either the understanding of, or the certainty with which different ethnic groups responded to questions. The interviewers, who may not have been typical of the residents in terms of age, sex or ethnicity, could have introduced bias, though all were skilled market researchers who had been briefed adequately. The under-portrayal of Pacific people in this survey is unlikely to have biased the findings. The effect would have been towards the null while statistically significant differences related to ethnicity were found. The gender misrepresentation might have disguised a true effect but that was not found on adjusting the responses to the study population's gender distribution.

The reported 65% overall use of fluoride toothpaste was markedly lower than the estimated 95% of toothpaste sold containing fluoride in 1998.<sup>6</sup> Data from a Porirua survey showed that 26% of Pacific and 23% of Maori, compared with 5% of European children, did not use fluoride toothpaste, or even brush their teeth each day.<sup>6</sup> The study findings probably demonstrate ignorance of the contents of toothpaste rather than differential buying practices by Onehunga residents. The level of opposition to fluoridation was comparable to that found in Quebec by Levallois et al.<sup>7</sup>

In the Auckland region there are appreciable differences in the proportions of five year old children who are caries-free both by race and whether their home water supply is fluoridated or not (European 77% v 67%, Maori 47% v 40%, Pacific People 41% v 31%, Other 60% v 56%), (Dalton J, personal communication). Many studies have shown water fluoridation to dramatically reduce dental caries.<sup>8,9</sup> Riley et al's work demonstrated it to lessen dental caries more in materially deprived wards in England than in affluent ones. This survey shows that the Pacific adults, whose children might benefit most, have the least knowledge on the topic. The lesser ability of younger people to specify the main purposes for water fluoridation is in accord with Australian experience.<sup>10</sup>

Ethnicity is strongly associated with almost every measure of health and disease. The relatively poor health status of Maori and Pacific people living in New Zealand results from a number of factors but is mostly due to poorer socio-economic circumstances.<sup>11</sup> As it is one of the strongest cultural influences, ethnicity is often used as a proxy for 'culture' but this can lead to incorrect conclusions about the effect of cultural influences on health. Durie describes 'diverse Maori realities' with respect to health and social, cultural and economic determinants with, in many cases, inter-Maori differences that are more marked than inter-ethnic ones.<sup>12</sup> Similarly Pacific people are not a homogeneous group.

The successful implementation of water fluoridation depends upon support from the public. The significant difference in the familiarity with fluoridation among the four ethnic groupings has important implications when consulting residents of their wishes on this topic. Public opinion surveys reveal community support for water fluoridation to be high. However Chitke and Brand's survey indicated that most people do not know what water fluoridation is or does, though most were in agreement that it should be implemented to reduce tooth decay.<sup>13</sup> This survey's findings on participants knowledge on oral hygiene differ from those found in South Australia.<sup>10</sup> More needs to be understood about the public's knowledge, attitudes and beliefs on the topic; the role they feel able to take in the decision making process, and the information they desire and how to acquire it when participating in the process. Lowry et al's qualitative study in England demonstrated that the general public wish to be informed of water fluoridation plans but do not see themselves as the appropriate implementation arbiters.<sup>14</sup> Onehunga showed similar views with users wishing to be consulted by a referendum, as is proposed. The possible anti-bias within the press has to be considered in designing any information strategy.<sup>15</sup> However it may be that the use of propaganda techniques can undermine the case being presented.<sup>16</sup> Decision making by either health professionals or the citizens themselves rather than elected representatives was preferred. This is in accord with Hastings et al's findings.<sup>17</sup>

The Centers for Disease Control state that "water fluoridation remains the most equitable and cost-effective method of delivering fluoride to all members of most communities, regardless of age, educational attainment, or income level."<sup>18</sup> If this is to be achieved in New Zealand education is required to empower the community to request it be implemented, especially among those who stand to benefit most; also to give the public the confidence to make judgements on the topic. Appreciable knowledge gaps on fluoridation have been demonstrated in the population studied with significant ethnic differences. These conclusions require to be considered when developing fluoridation advocacy strategies. The extended family structure is at the centre of Pacific cultures, behaviours and beliefs. The Maori view of public health focuses on empowering the whanau to take responsibilities for their needs. This sharing can be a catalyst for greater health promotion effectiveness.

This study suggests that the New Zealanders wish to be involved in decision making regarding fluoridation of their water supplies. Further research is needed to confirm whether Lowry et al's view that the public does not want to make decisions on the implementation of fluoridation is correct in the New Zealand context.<sup>14</sup>

## **Acknowledgement**

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## References

- <sup>1</sup>McDonagh MS, Whiting PF, Wilson PM, Sutton AJ et al. Systematic review of water fluoridation. *BMJ* 2000; **321**: 855-9.
- <sup>2</sup>*Review of water fluoridation and fluoride intake from discretionary fluoride supplements*. Melbourne, Aus: NHMRC, 1999.
- <sup>3</sup>Bates M. Fluoridation of water supplies – an evaluation of recent epidemiological evidence. Porirua, NZ: Epidemiology Group ESR, 2000.
- <sup>4</sup>Wright JC, Bates MC, Curtress T, Lee M. The cost-effectiveness of fluoridating water supplies in New Zealand. Porirua, NZ: Epidemiology Group ESR, 1999.
- <sup>5</sup>*The New Zealand Health Strategy: Discussion Document*. Wellington, NZ: Ministry of Health, 2000.
- <sup>6</sup>*Progress on Health Outcome Targets 1998*. Wellington, NZ: Ministry of Health, 1998
- <sup>7</sup>Levallois P, Grondin J, Gingras S. Knowledge, perception and behaviour of the general public concerning the addition of fluoride in drinking water. *Can J Public Health* 1998; **89**: 162-5.
- <sup>8</sup>Riley JC, Lennon MA, Ellwood RP. The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. *Int J Epidemiol* 1999; **28**(2): 300-5.
- <sup>9</sup>Jones CM, Worthington H. The relationship between water fluoridation and socio-economic deprivation on tooth decay in 5-year-old children. *Br Dent J* 1999; **186**(8): 397-400.
- <sup>10</sup>Roberts-Thomson KF, Spencer AJ. Public knowledge of the prevention of dental decay and gum diseases. *Aus Dent J* 1999; **44**(4): 253-8.
- <sup>11</sup>*The Social, Cultural and Economic Determinants of Health in New Zealand: Action to Improve Health*. Wellington, NZ: Ministry of Health, 1998.
- <sup>12</sup>Durie MH. *Whaiora: Maori Health Development*. Auckland, NZ: Oxford University Press, 1994.
- <sup>13</sup>Chitke U, Brand AA. Attitudes to water fluoridation in South Africa 1998. Part I. Analysis by age, sex, population and province. *SA Dent J* 1999; **54**(11): 537-43.
- <sup>14</sup>Lowry RJ, Thompson B, Lennon MA. How much do the general public want to be involved in decisions on implementing water fluoridation? *Br Dent J* 2000; **188**(9): 500-2.

<sup>15</sup>Lowry RJ. What the papers say: How does the United Kingdom press treat water fluoridation and does it matter? *Br Dent J* 2000; **189(1)**: 14-8.

<sup>16</sup>Lowry RJ. Antifluoridation propaganda material – the tricks of the trade. *Br Dent J* 2000;**189(10)**: 528-30.

<sup>17</sup>Hastings GB, Hughes K, Lawther S, Lowry SJ. The role of the public in water fluoridation: public health champions or anti-fluoridation freedom fighters? *Br Dent J* 1998; **184(1)**: 39-41.

<sup>18</sup>Achievements in Public Health, 1900-1999; Fluoridation of drinking water to prevent dental caries. *MMWR* 1999: **48(41)**: 933-40.

**Table 1 Demographic details of Onehunga Water Treatment Zone population and resident study sample**

		<b>Population</b>	<b>Sample</b>	$\chi^2$
<b>Age (yr.)</b>	18-44	11234	170	NS
	45 and over	7489	112	
<b>Gender</b>	Male	8613	111	*
	Female	10110	171	
<b>Marital status</b>	Never married	2996	51	NS
	Ever married	15727	231	
<b>Ethnicity</b>	NZ European	11047	192	**
	NZ Maori	2060	30	
	Pacific Islander	3557	36	
	Asian and other	2059	24	

$\chi^2$  NS not significant, \* P≤0.05, \*\* P≤0.01

**Table 2 Responses of resident and business samples**

		<b>Residents</b>	<b>Business</b>	$\chi^2$
<b>Know reasons for fluoride</b>	Yes	78%	60%	**
	No	22%	40%	
<b>Is supply fluoridated</b>	Yes	26%	22%	**
	No	27%	10%	
	DK	46%	68%	
<b>In favour of fluoridation</b>	Yes	48%	47%	*
	No	21%	27%	
	DK	30%	27%	
<b>Any health benefits</b>	Yes	64%	58%	**
	No	10%	22%	
	DK	25%	20%	
<b>Any health hazards</b>	Yes	24%	24%	*
	No	20%	38%	
	DK	55%	38%	
<b>Appropriate for Council to make decision</b>	Yes	23%	40%	*
	No	67%	52%	
	DK	9%	8%	
<b>Want local referendum</b>	Yes	68%	82%	*
	No	9%	18%	
	DK	23%	15%	
<b>Total</b>		282	50	

DK = Don't Know

 $\chi^2$  \*  $P \leq 0.05$ , \*\*  $P \leq 0.01$

**Table 3 Responses of ethnicity groups of residents**

		<b>European</b>	<b>Maori</b>	<b>Pacific People</b>	<b>Asian &amp; other</b>	$\chi^2$
<b>Use fluoride toothpaste</b>	Yes	69%	63%	53%	54%	*
	No	17%	7%	17%	13%	
	DK	14%	30%	30%	33%	
<b>Know reasons for fluoride</b>	Yes	90%	70%	39%	50%	**
	No	10%	30%	61%	50%	
<b>Is supply fluoridated</b>	Yes	31%	27%	11%	4%	**
	No	32%	33%	11%	4%	
	DK	37%	40%	78%	92%	
<b>In favour of fluoridation</b>	Yes	55%	33%	33%	38%	**
	No	23%	23%	11%	13%	
	DK	22%	43%	56%	50%	
<b>Any health benefits</b>	Yes	73%	63%	33%	42%	**
	No	11%	7%	8%	8%	
	DK	16%	30%	58%	50%	
<b>Any health hazards</b>	Yes	28%	37%	6%	4%	**
	No	22%	17%	14%	13%	
	DK	50%	46%	80%	83%	
<b>Appropriate for Council to make decision</b>	Yes	21%	20%	36%	21%	**
	No	73%	70%	45%	54%	
	DK	5%	10%	20%	25%	
<b>Want local referendum</b>	Yes	74%	70%	42%	54%	**
	No	11%	10%	3%	4%	
	DK	15%	20%	55%	42%	
<b>Total</b>		192	30	36	24	

DK = Don't know

$\chi^2$  \* P≤0.05, \*\* P≤0.01

**Table 4 Responses of age and marital status groups of residents**

		<b>18-44 Yr.</b>	<b>45 &amp; + Yr.</b>	$\chi^2$	<b>Never married</b>	<b>Ever married</b>	$\chi^2$
<b>Use fluoride toothpaste</b>	Yes	71%	56%	**	72%	64%	NS
	No	8%	27%		14%	15%	
	DK	21%	17%		14%	21%	
<b>Know reasons for fluoride</b>	Yes	71%	88%	**	59%	82%	**
	No	29%	12%		41%	18%	
<b>Is supply fluoridated</b>	Yes	24%	29%	**	23%	26%	NS
	No	22%	35%		18%	30%	
	DK	54%	36%		59%	44%	
<b>In favour of fluoridation</b>	Yes	49%	47%	*	39%	50%	**
	No	16%	28%		12%	23%	
	DK	35%	25%		49%	27%	
<b>Any health benefits</b>	Yes	57%	75%	**	47%	68%	**
	No	9%	11%		6%	11%	
	DK	34%	14%		47%	21%	
<b>Any health hazards</b>	Yes	21%	29%	*	16%	25%	NS
	No	16%	25%		19%	20%	
	DK	63%	46%		65%	55%	
<b>Appropriate for Council to make decision</b>	Yes	26%	19%	NS	24%	23%	**
	No	62%	74%		55%	70%	
	DK	12%	7%		22%	7%	
<b>Want local referendum</b>	Yes	65%	72%	*	65%	69%	NS
	No	7%	13%		4%	10%	
	DK	28%	15%		31%	21%	
<b>Total</b>		170	112		51	231	

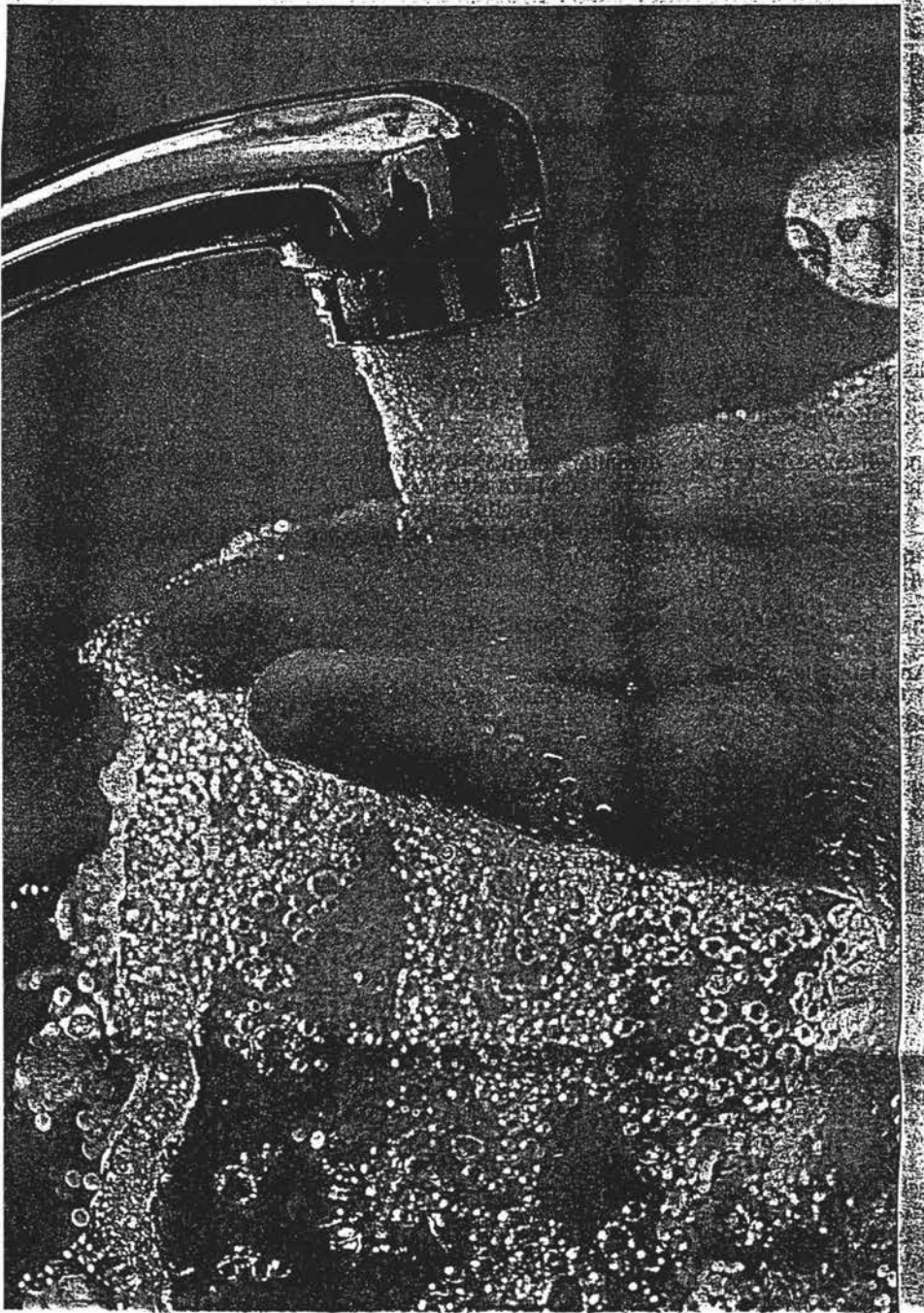
DK = Don't Know

$\chi^2$  NS not significant, \* P≤0.05, \*\* P≤0.01

# **Appendix F**

Media coverage of Onehunga water fluoridation issue

# DIALOGUE





# Last days for fluoride poll

Public health experts fear a poor response from Onehunga residents.

By FRANCESCA MOLD  
health reporter

A postal survey asking Onehunga residents whether they want to join the rest of Auckland City in fluoridating their water supply closes this week.

Onehunga is the only area within Auckland City Council boundaries to have an unfluoridated water supply.

The Papakura District Council voted last month to add fluoride to its water.

The Auckland City Council has spent \$45,000 on a postal preference survey which has been sent out to people registered on the electoral roll.

The survey result is not binding and a decision will be made by the Auckland City Council next year. But public health

experts are concerned there will be a poor response rate to the postal survey.

A similar survey in Onehunga concerning the development of a new library received replies from just 3 per cent of residents.

The Auckland medical officer of health, Donald Campbell, said most who responded would be likely to be strongly for or strongly against fluoridation.

Dr Campbell said he believed fluoridation was an effective public health measure.

It was inequitable for the whole of Auckland City apart from Onehunga to be fluoridated, he said.

Dr Campbell said water fluoridation prevented between 2.4 and 12 decayed teeth a person and was an effective pre-

vention measure for adults and children. Research has shown possible links between fluoride, cancer and increased likelihood of fractures.

But Dr Campbell said recent reviews of fluoride research in Britain and Australia had largely dismissed this research.

The only proven risk of increased intake of fluoride was fluorosis - mottling of the teeth, said Dr Campbell.

Dr Gay Keating, of the Public Health Association, said teaching dental hygiene was important but it was equally vital that each community helped lower-income families by having the water supply fluoridated.

Health Minister Annette King has written to mayors recommending all water supplies be fluoridated.

# Baby-boomers feared trips to murder house

There was nothing quite so terrifying to my generation of schoolkids as the rustle of the dental nurse's starched uniform as she swept into the classroom to announce her next victims for the murder house.

I still remember the glorious day a kid made a break for it. There he was haring past our classroom window away from the school with the white-uniformed dragon in hot pursuit.

We were on our feet, cheering him on as he sped from the school grounds to freedom. Even our teacher was willing him on.

To us baby-boomers, dental decay was a painful fact of life. I have a mouthful of old fillings to remind me.

The fluoridation of water supplies began in New Zealand in 1954 and gradually resulted in dramatic reductions in tooth disease.

Between 1980 and 1994 the average number of missing or filled teeth in Form 2 pupils fell from 5.1 to 1.33. And that was with only about half the country's water supplies fluoridated.

Since then, however, the decay figure has taken a turn for the worse, rising to 1.53 in 1996, 1.62 in 1997.

For Health Minister Annette King, once a "dragon" herself, this is unacceptable and she has fired off letters to 61 mayors who preside over unfluoridated water supplies expressing her concern.

Among the recipients were the mayors of Auckland City, Franklin and Papakura and the commissioner of Rodney.

Not fluoridating water supplies was putting the health and well-being of people, especially young people, at



rudman's city

risk, she thundered.

Speaking from Wellington yesterday, Annette King worried that we have become complacent about fluoride. "People think we don't need it anymore."

What seems as big a worry is that only 57 per cent of the population has access to fluoridated water supplies. Among those missing out are the residents of the old Onehunga borough, the Gulf islands, which have no public water supply, Franklin and parts of Rodney and Papakura.

Annette King's letter coincides with moves in Onehunga by parents, teachers and health professionals to have the local spring water supply fluoridated. Before amalgamation in 1989, Onehunga residents voted against fluoridation.

Proponents have been campaigning on and off since to overthrow this decision. They recently convinced the Auckland City Council to vote \$45,000 for "consultation" on the issue. This will take the form of a non-binding "general preference postal survey" of locals.

Just why we feel the need to go through such a convoluted rigmarole over adding less than one part a million of something so obviously beneficial to the community is a mystery to me. After all we add a touch of iodine to

table salt to prevent goitre without a squeak of protest from anyone.

In a report to the council in support of fluoridating Onehunga's water Auckland medical officer of health Dr Donald Campbell argues that water fluoridation prevents, for each of us, between 2.4 and 12 decayed, missing or filled teeth.

In recent years, the widespread use of fluoridated toothpaste means there has been a dramatic decline in tooth decay even in areas where the water supply is not treated. However, he says the areas with fluoridated water show even better results.

This is particularly so where the risk of tooth decay is highest — among Maori and lower socio-economic groups. In Auckland City, for example, he compared 5-year-old children in non-fluoridated areas such as Onehunga with 5-year-olds in fluoridated parts of the city.

With Maori kids, 44 per cent in the non-fluoridated area were free of dental disease, compared with 54 per cent in fluoridated areas. For Pacific Island kids, the comparable figures were 31 per cent and 45 per cent. For Pakeha, the figures were 57 per cent and 83 per cent.

Dr Campbell concludes that "children resident in areas with non-fluoridated water supplies have poorer dental health than their peers who receive reticulated fluoridated water."

Frankly, the case seems so convincing for fluoridation that I wonder why Annette King doesn't just act. She says she can't — it's a local issue.

That being so, it's over to Auckland City to take the lead and get on with it.

# Fluoridation: the argument revives

Brian Rudman finds the case for fluoridating water so convincing that he wonders why Annette King doesn't just act. He means pass legislation to compel fluoridation throughout the country.

He then urges the Auckland City Council to "get on with it." I suppose he means it should ignore the response to a survey it is sending to Onehunga residents for comment on whether we wish to have our spring-water supply fluoridated. The springs have been famous for centuries. We voted against fluoridation in a borough poll some years ago.

The case against fluoridation is simple. While it might be clear that fluoride helps to prevent tooth decay in children (as does much else), claims concerning its negative effect on later bone conditions have not been disproved and no benefits are claimed for adult teeth. So why add fluoride to a water supply for the questionable benefit of a minority of its users when the simple choice of fluoride toothpaste is available? And why especially to a natural spring water known for its excellence?

**Murry Norman.**  
Onehunga.

I strongly endorse, on behalf of the Auckland Regional Dental Service, Brian Rudman's column

supporting an increase in the availability of fluoridated water in the Auckland region. This is the most effective (and cost-effective) way to further reduce our dental disease levels. A large body of research has shown fluoridation of water supplies at one part per million to be a safe measure. It is encouraging for all of us involved in dentistry to have the support of the Health Minister in the promotion of this valuable preventive measure.

However, emotive language such as "trips to the murder house" and "dragon," although eye-catching, belong firmly in the past. Their repeated use helps to ensure the survival of inaccurate, outdated stereotypes. The modern dental therapist is a highly skilled health provider able to deliver virtually painless dentistry under local anaesthesia to a high standard. The therapists I work alongside are caring, compassionate and capable practitioners and the public health services would be poorer without them. So let's do away with out-of-date, unhelpful imagery and give credit where credit is due.

**John Dalton,**  
Acting principal dental officer

How long must we battle against pressure to poison our water supplies with sodium fluoride?

Health Minister Annette King's call for councils to consider this foolish suggestion is annoying and worrying. We have enormous amounts of information now showing that there is no advantage at all in this dangerous procedure.

For instance, Professor Hardy Limeback, head of preventive dentistry at the University of Toronto and a spokesman for the Canadian Dental Association for over 12 years, is just one more expert who no longer supports fluoridation.

His opposition came about after he reviewed the scientific literature and concluded that there is very little, if any, dental benefit from swallowing fluoride. "In my opinion," he said, there is no question that the risks now far outweigh the benefits." Moreover, Dr Limeback agreed that fluoride adversely affects bones and teeth. Fluoride accumulates in the bones. Furthermore, there hasn't been a single study to show that exposure over a lifetime is safe.

Having genetically engineered food forced down our throats without permission and our children exposed to high levels of chemical spray is bad enough. Must we also have to fight this ridiculous old wives' tale, too?

**Robert Anderson,**  
Physicians and Scientists for Responsible Genetics.

## Bottled water and fluoride

The letter from Bill Wilson, president of the Pure Water Association, illustrates the deliberate selectivity of information by those on both sides of this debate. The same issue of the *British Medical Journal* quoted by Mr Wilson also points out that more than 360 million people in about 60 countries worldwide are exposed to fluoridated water, both naturally occurring or introduced.

The same issue, reviewing 214 studies, although admitting that the quality of studies was low to moderate, stated: "Water fluoridation was associated with an increased proportion of children without caries and a reduction in the number of teeth affected by caries."

Searching of the literature and the internet can easily provide articles that conform with one's own point of view, pro or con. Personal experience is more convincing. In 50 years of medical practice I have seen dramatic changes in children's teeth associated with the introduction of fluoridation. I have had to help dentists to cope with mouths in

which every tooth is "rotten to the core."

I would ask Mr Wilson what is his personal experience of the incidence of dental fluorosis which he cites as an (accepted) side-effect of fluoridation? The reviewer he quotes would rather use fluoridated toothpaste. Fluoridation of the drinking supply is for the benefit of children who wouldn't know one end of a toothbrush from the other, let alone the benefit of toothpaste.

Graham Gordon:  
Stratford.

## The fluoride debate

Last year, Dr. Al-Murieb, of the Auckland School of Medicine, was awarded a master of public health degree for his study which showed a relationship between fluoride and hip fracture.

Using calculations from the odds ratios in his study, it was calculated that about 870 extra hip fractures and 200 related deaths occur as a result of fluoride intake.

One recommendation from the study was that older people should use non-fluoridated water. One should always be cautious about individual studies but this one confirms the findings of eight previous studies showing a relationship between fluoride and hip fractures.

Bill Wilson,  
President,  
Pure Water Association.

# Bottled water bad for teeth

The 'pure water fad' is damaging young people's teeth because the drink contains only a tiny amount of fluoride, say dentists.

By **FRANCESCA MOLD**  
health reporter

The health fad for drinking filtered and bottled water is raising dentists' concerns that a generation of young people are doing serious damage to their teeth.

Leading dentists fear that an increasing number of children and teenagers are inadvertently cutting fluoride from their diet by replacing tap water with bottled and filtered varieties.

There is also concern that constant sipping of sport drinks is causing an "acid attack" on the teeth of the young.

Research shows an approximate 20 per cent increase in the worldwide consumption of bottled water, with sales reaching more than \$4 billion a year in the United States.

Bottled water contains a maximum of just 0.1 part of fluoride per million, compared to New Zealand tap water, which is usually about 0.7 per million.

The dentists say the lack of fluoride — a mineral which prevents tooth decay — is causing a rise in cavities among young, otherwise healthy people.

Auckland-based public health dentist Bob McKegg called for a major information campaign aimed at young people who did not seem aware of the importance of fluoride.

He said parents also needed to be aware that when they thought they were giving children purer water by buying bottles or filtering it, they



**PRISTINE:** But what about fluoride?

were removing fluoride from their diet.

Dr McKegg said there appeared to be an increase in the number of children with tooth decay from homes with water filters.

"Many people, especially those in upper socio-economic areas, are using microfilters and then turning up with buckets of dental disease."

Representatives from leading bottled water companies could not be contacted for comment yesterday.

An Auckland Healthcare special-

ist paediatric dentist, Callum Durward, said "sipper" bottles, containing highly acidic fruit or sport drinks, were also harmful.

These drinks appeared to be a healthy alternative to soft drinks, he said, but dentists found they severely eroded tooth enamel.

Dr Durward said it was becoming common for children and even preschoolers to walk around sipping sports drinks. Every time they sipped, their teeth suffered a damaging "acid attack," he said.

"It's the constant sipping that causes the damage. Teeth can handle four to five acid exposures a day but they can't cope with 15 or more."

The problem was worst in areas with non-fluoridated water, such as Northland and parts of South Auckland.

The sipper bottles are even being blamed for boosting waiting lists for children needing tooth repair or removal under an anaesthetic.

Dr Durward, who operates at Green Lane and Middlemore Hospitals, said the wait for surgery had rocketed to six months.

"This is not acceptable! The children are in pain and susceptible to infection and abscesses while they are waiting."

About nine children a week had to be treated under anaesthetic for teeth restoration. A large number of preschoolers also had to have their teeth removed because of decay.

"People really have no idea they are causing this kind of damage with a drink."

# Onehunga fluoride poll confirms council's folly

Last July, Auckland City councillors chickened out of a vote on fluoridating Onehunga's water supply.

Instead, they kicked for touch and agreed to spend \$45,000 on public consultation.

What an expensive rod for their backs that decision was.

The results are in, and the flat-earthers against fluoridation have scored a substantial 62 per cent versus 33 per cent victory.

Of course the council insisted at the time of the poll that it was non-binding. I am also sure that pro-fluoridaters will point to the fact that only a third of the 12,840 ballot papers were returned, giving it as a reason to reject the results of this non-poll.

But legitimate referendum or not, the result is a political victory for opponents of fluoride which nervous election-year councillors will find hard to ignore.

After all, the 34 per cent turnout is more than respectable, on a par with the 37.9 per cent who voted in last November's Avondale-Roskill byelection.

It is also close to the 39.6 per cent of Papakura residents who voted in the binding fluoridation referendum last November. In that case, 59.5 per cent supported fluoridation.

Just why Auckland City chose this method of public consultation beats me. Councillors must have known that the vast majority of citizens who either don't care, or expect their representatives to just get on and do the right thing, would not reply.

A more accurate gauging of public opinion would have been to conduct a random opinion poll.

This still raises the question of why polling on such an open-and-shut public



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health issue should be thought necessary.

I am as much a democrat as the next person. But the thought of living in the sort of purist democracy where everything is decided by popular referendum is very scary.

It might slow things down a bit, but I prefer my democracy to have a layer of politicians and bureaucrats and judges between the talkback mob and myself.

If fluoridating the water supply is a good thing, and scientifically proven to be so, surely they should just get on and do it.

Why councillors continue to be intimidated by the anti-fluoride conspiracists is one of politics' little absurdities.

It is as though the councillors take seriously the conspiracists' proposition that, for nearly 50 years, generations of medical officers of health and water engineers have been deliberately and intentionally poisoning their fellow citizens.

In Auckland the situation is even sillier. From Otahuhu across to Avondale, citizens are fed fluoridated water without any suggestion from elected officials that it is a bad thing. But when it comes to the little enclave of Onehunga, procrastination reigns.

The reason is historical. The old borough had its own underground water source, and local activists see retention of this water supply as a mark of independence from the wider city.

They also claim it is purer, bubbling up

from an underground spring, and they do not want it sullied by introduced pollutants like fluoride.

The truth is, the famed spring water is not quite as pure as they make out. It comes from an aquifer running down from One Tree Hill and surrounding areas.

Apart from anything else, the spring water has high nitrate levels which, given the urban surrounds, probably come from broken sewer pipes. But let us not go down that path.

In 1989, before amalgamation, Onehunga voted against fluoridating its water supply. Over the years, proponents have fought to overturn this decision. Nine months ago they were back before the city council.

It wimped out by calling for consultation. The results of this go before the next Maungakiekie Community Board meeting. The city council works committee gets a report on March 7.

Despite the non-binding poll results, it's a no-brainer. Fluoridation of our water supplies since 1954 has led to a dramatic reduction in tooth decay.

Health Ministry figures show that Onehunga 5-year-olds have more rotten teeth than their mates in fluoridated Mt Roskill.

Bottled fruit juices and sports drinks have in recent times become an additional threat to young teeth, but that has not lessened the need for fluoride.

The rest of Auckland benefits from this public health measure; it hardly seems fair that Onehunga children continue to miss out.

It is time to call the anti-fluoriders' bluff and demand they produce a local victim or two.

For all their wailing, I can't recall them ever managing that.

# Board tries to save kids from fluoride ignorance

Great news for the kids of Onehunga. On Wednesday night, the local Maungakiekie Community Board voted 5-2 in favour of joining the rest of the city in adding fluoride to their public water supply.

The two against were Auckland City councillor Catherine Harland and board deputy chairman Geoff Abbot.

The motion said the board was recommending this course of action to the March 7 meeting of the city's works committee "because in our view fluoridation has a clear and substantial public health benefit, particularly for children, considering the socio-economic area we live in."

Happily, my fears that the politicians might have been swayed by the skewed results of the council's non-binding "referendum" were misplaced.

What I suspect did save the day was the results of a random telephone poll of Onehunga voters, presented to Wednesday's meeting by Auckland District Health Board adviser Nicola Young.

This revealed that in the August 2000 poll of 282 residents, 48 per cent were for fluoridation, 21 per cent were against and 30 per cent said they didn't know.

This was the reverse of the council's National Research Bureau postal poll, where, in a 34 per cent return of ballot papers, 62 per cent were against fluoridation and 33 per cent were in favour.

The differences between the two results, to say nothing of the public confusion and ignorance revealed by the Auckland Healthcare-funded poll, strengthen my belief that public health decisions are too important to be left to referendums or opinion polls.

What stands out in the phone poll



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result is the widespread ignorance. The authors diplomatically note that "appreciable gaps were identified in this community's knowledge on fluoridation with important differences based on ethnicity and age demonstrated."

That, I'm afraid, is putting it mildly. Asked if they knew the reasons for fluoridating water, 40 per cent of the business respondents and 22 per cent of the residents said they did not.

Asked if their non-fluoridated water was fluoridated, 26 per cent of residents and 22 per cent of businesses incorrectly said it was. Only 27 per cent of residents and 10 per cent of businesses got it right. The rest confessed not knowing.

Ignorance was greatest among the

young (18-44) and among the ethnic groups which other research has shown would most benefit.

Only 39 per cent of Pacific Islander knew the reasons for fluoridating, compared with 50 per cent of Asians and others, 70 per cent of Maori and 90 per cent of Europeans.

Asked if there were any health benefits, 73 per cent of Europeans said there were, compared with 63 per cent of Maori, 42 per cent of Asians and 33 per cent of Pacific Islanders.

As for any health hazards, 28 per cent of Europeans and 37 per cent of Maori said yes, along with just 6 per cent of Pacific Islanders and 4 per cent of Asians.

The reverse side of this is that 80 per cent of Pacific Islanders just did not know.

As researcher Lynette Holbrook, from the Institute of Food Nutrition and Human Health at Massey University observes: "The Pacific adults whose children might benefit most have the least knowledge on the topic."

The widespread ignorance revealed in this survey exposes the failure of public health officials to sell the fluoride message. It also underlines that any referendum on the issue will be about matter other than the merits of this invisible and tasteless additive to the water supply.

Despite the widespread ignorance — or perhaps because of it — 68 per cent of the telephone poll participants reckon fluoridation should be decided by local referendum.

They said that last August. However, just four months later Onehunga voters were given the opportunity to vote in such a poll and only 34 per cent bothered.

Meanwhile, the kids' teeth continue to



A WASHOUT: Tapping public opinion.

# Decision on fluoridation kick in teeth for young

Just a month ago, I was celebrating as great news for the kids of Onehunga the decision of the local community board to support the fluoridation of the local water supply.

My cheers were premature.

Last Thursday, Auckland City councillors voted 10-9, with one abstention, to overrule the locals and abandon the project.

The one on the fence was mayor Christine Fletcher. She neatly epitomises the muddled motives of some of those who failed to vote in favour.

Before, during and after the debate the mayor was keen to say how supportive she is of this well-proven, tooth-saving, public health measure.

She couldn't vote for it, though, because a council-funded survey had shown that most respondents were opposed.

That the local Maungakiekie Community Board and the city's works committee had both found it possible, despite the referendum results, to support fluoridation failed to sway the mayor or the 10 opposing councillors: Gray Bartlett, Victoria Carter, Barbara Goodman, David Hay, Catherine Harland, Maire Leadbeater, Jon Olsen, Noelene Raffills, Faye Storer and Jan Welch.

If ever there was a simple, safe and easily quantifiable public health measure it is surely the putting of a few drops of fluoride into the nation's drinking water. Unfortunately, both here and abroad, a handful of obsessives are waging war against the water "poisoners."

Following local government amalgamation in 1989, Onehunga entered the new expanded Auckland City with its very own unfluoridated water supply.

The rest of the city's supply was fluoridated



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dated water from the regional dams in the Hunuas and Waitakeres and a group of Onehunga parents and dental professionals wanted the local kids to enjoy the chance of better teeth.

Last July, the proponents pleaded with the council to add the chemical to Onehunga's water supplies. Councillors ducked the issue by voting to spend \$45,000 on public consultation.

The big mistake here was to go for a half-pie referendum. I say half-pie because the supporting documentation to assist the voters was totally unbalanced.

The pro-material, prepared by Auckland Healthcare, was calm and uncontroversial.

The opposition statement was a scare-mongering rave from something called the New Zealand Pure Water Association.

It opens by claiming that the fluoride in Auckland water is a mix of dirty contaminated water and a toxic radioactive waste product. Then it warms up.

Only a third of the ballot papers were returned, the result being a 62 to 33 per cent victory to the opponents.

The polling instructions had stated that the vote would not be binding, but that was always going to be a weak argument for a politician to fall back on. The die seemed cast.

Then a remarkable thing happened. First the community board took a brave

and informed stand and despite the referendum, voted 5-2 to join the rest of the city in enjoying the benefits of fluoridated water. That was just a month ago.

On March 7, the city council's works committee took its lead from the local council and followed suit.

Last Thursday, one expected that the council would agree.

But instead, it lost sight of the real issue and agonised over such side issues as flawed referendum.

Some, the mayor included, refused to vote for a measure they believe in fluoridation — because they felt undemocratic to go against the results of the non-binding, poorly supported referendum.

Mrs Fletcher even mused aloud at a meeting about holding another referendum at the time of the October local body elections. She got little support, which is not surprising.

Where would such a referendum start and end?

If you let the people of Onehunga vote on fluoride, why not the people of Pongaroa and Mission Bay, too?

Why such a simple public health measure should be deemed a candidate for referendum at all is beyond me. We do have polls to decide whether or not to vacillate or to decide whether food preparers' sandwich bars should wash their hands regularly. We accept expert advice.

Mrs Fletcher and the other non-supporters should have done just that last Thursday.

By ignoring it, they have guaranteed that Onehunga kids will suffer more tooth decay and disease than their mates in other parts of the city.



# Rejection of fluoride to benefit all water users



**Keith Rankin** says the decision not to fluoridate Onehunga's water supply was correct for several reasons, not least the upholding of democracy.

To fluoridate or not to fluoridate, the local spring water? That was the question that the people of Onehunga had to decide. Their will prevailed.

The Auckland City Council voted 10-9 to retain the status quo, but not before passions were raised by both supporters and opponents of fluoridation.

A referendum of sorts was held among Onehunga residents. In a turnout that was about as high as you can expect to get for a stand-alone postal ballot (about one-third of ballots were returned), there was a two-to-one rejection of fluoridation. A majority of members of the Maungakiekie Community Board and various commentators, including *Herald* columnist Brian Rudman, believed that the residents' poll should

were not expecting to receive. Such voters responded to the leading questions asked of them in an entirely predictable manner.

The Onehunga poll, however, was a proper referendum. The public was asked to either support or reject a specific proposal that had been sanctioned by public health experts.

Opposition to fluoride is not simply the ravings of conspiracy theorists, as fluoridation proponents insinuate.

The legitimate fear is that public health technocrats do not actually know all that there is to know about fluoride, and that unintended harm may result from excess fluoride.

The question then becomes one of whether the gains from having fluoride in

6 The legitimate fear is that public health technocrats do not know all that there is to know about fluoride, and that unintended harm may result from excess fluoride. 9

To undermine the referendum community board proponents even reduced the results of a previously secret 18-month-old telephone survey that appeared to contradict the referendum result. To get such a different result, the people sampled by telephone were almost certainly asked leading questions that usually obliged agreement.

As a political economist — and as an Onehunga resident who is equally happy to drink fluoridated or unfluoridated water — these kinds of anti-democratic rationalisations worry me.

The referendum non-response rate was most likely due to a combination of public ignorance and indifference. Most people had no opinion.

Of those residents who did have an opinion, the weight of opinion was clearly in substantially against fluoridation.

In this regard, the Onehunga poll was most certainly more reliable than the referendums held with the general election in 1999. In those polls, many people who could not have chosen to participate felt obliged to fill in ballot papers that they

were not expecting to receive. Such voters responded to the leading questions asked of them in an entirely predictable manner.

The Onehunga poll, however, was a proper referendum. The public was asked to either support or reject a specific proposal that had been sanctioned by public health experts.

Opposition to fluoride is not simply the ravings of conspiracy theorists, as fluoridation proponents insinuate.

The legitimate fear is that public health technocrats do not actually know all that there is to know about fluoride, and that unintended harm may result from excess fluoride.

The question then becomes one of whether the gains from having fluoride in the water exceed the risk of harm.

The gains from having fluoride in water have not yet been presented to the public in an unambiguous way.

The main beneficiaries of fluoridation are children. But we need to consider children of different ages.

Few would doubt that 10-year-old children who don't clean their teeth are better off with fluoride in the water. But are there any fluoridation benefits to a two-year-old child who swallows substantial amounts of fluoride toothpaste twice a day?

The information that we have seems to come from interested parties. Fluoridation proponents assert that children in Onehunga have 50 per cent more tooth decay than other Auckland children. But maybe the children of Glen Innes also have 50 per cent more tooth decay.

We need to compare dental health statistics suburb by suburb.

How do the residents of Onehunga West compare with their middle-class neighbours in Hillsborough and Three Kings?

How do children from the low-income Maori and Pacific families of Onehunga East compare with comparable families in neighbouring Mangere and Otahuhu?

We would be well served by a clear and unbiased presentation of the evidence of children's dental health in different parts of the cities of Auckland.

Simple statistical techniques are available to determine whether bad dental health in Onehunga is caused by a lack of fluoridated water or by other causes.

All of Auckland benefits if one part of Auckland has unfluoridated water. Call it an experiment.

Keeping Onehunga unfluoridated means that researchers will be able to study the effects of fluoridation over the long term. Onehunga serves as the study's control group.

A continuation of the status quo also means that both supporters and opponents of fluoridation can choose to reside in a place that suits their preference.

As an economist, I believe the market is always right. That maxim applies to public goods such as water as much as to pizzas and meat pies.

We need expertise in public health, just as in economics, statistics and other branches of science. But we also need humility from our experts.

According to one claim advanced in the Catching the Knowledge Wave project, the world's knowledge now doubles every seven years. Who knows what this exponential growth of knowledge will reveal about fluoride?

The more we know, the more we upwardly revise our estimates of what we don't know.

A future knowledge society will be less certain about what is true and what is not true than our Society of the 20th century was. Last century, too many of our decision-makers believed they knew everything there was to know. Fluoridation is a small matter that raises big questions.

■ Keith Rankin teaches economics and

# **Appendix G**

An example of Anti fluoridation group's mail drop

## A FEW OF THE EXPERT OPINIONS YOU'VE NEVER BEEN TOLD ABOUT !!

*"In view of the new evidence of harm, knowledge of which has not yet got through to the general public, it is only a matter of time before fluoridation is stopped. It will be stopped by an angry and outraged public. It should have been stopped following a responsible recommendation from health professionals"*

John Colquhoun BDS, DipEd, MPhil, PhD, Former Principal Dental Officer, Dept of Health, Auckland

*"Finally we found that in humans, the bone cancer incidence rate, mostly osteosarcoma, was around 50% higher in males living in fluoridated areas, and that the incidence of oral and pharyngeal cancers was 30-50% higher in fluoridated areas"*

John A. Vamduyannis, PhD, Bio-Chemistry, Delaware, Ohio

*"The plain fact that fluoride is an insidious poison, harmful, toxic and cumulative in its effects, even if ingested in minimal amounts, will remain unchanged - no matter how many times it is repeated in print, that fluoridation of water supplies is safe"*

Dr Charles G Heyd MD, Ex President, American Medical Association.

*"In my view, the evidence is quite convincing that the addition of Sodium Fluoride to the public water supply at one part per million is extremely deleterious (harmful) to the human body. A review of the evidence will disclose there is no convincing evidence to the contrary"*

John Flaherty, Justice of the Supreme Court, Pennsylvania

**Conclusions like these have led to fluoridation being stopped in -**  
Switzerland, Holland, Japan, Germany, Norway, Italy, South Africa, Denmark, France, Sweden, Chile, Austria, Egypt, Finland, Kenya, India, Greece, Luxembourg, Spain, Argentina, Hungary, Belgium, Yugoslavia, Britain (only 8% now fluoridated).

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