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Dental Fluorosis in the Blue Mountains and Hawkesbury Regions, NSW

Ikreet Singh Bal, BDS

(Punjabi University, India)

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Dedication

*This thesis is dedicated to my parents,
Mrs. Jaswinder Kaur Bal and
Brigadier Ajinder Singh Bal,
for encouraging me in my pursuit of higher education,
and for giving me all their support.*

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Summary and Recommendations

Exposure to fluoride from all sources, including fluoridated water, is a risk factor for dental fluorosis during the years of tooth development. With the advent of fluoride toothpaste, infant formula reconstituted with fluoridated water, and the availability of commercially prepared beverages using fluoridated water, the incidence of dental fluorosis is increasing in some communities.

This survey was conducted, in addition to a follow-up survey of caries experience, to evaluate the introduction of water fluoridation in the Blue Mountains region in 1992, and in the Hawkesbury region, already fluoridated since 1968. The water supply in Sydney is fluoridated to a target concentration of 1.0 ppm.

Schools surveyed were the same as those that had been randomly selected for the baseline survey in 1992. The permanent maxillary central incisors of the children were examined according to Dean's Index and then photographed (without prior drying).

A total of 1,352 children with permanent maxillary central incisors were examined. The overall prevalence of dental fluorosis was found to be 0.39. Dean's CFI values for the Blue Mountains and Hawkesbury regions were 0.70 and 0.63 respectively (Chi square = 36.65, $df = 5$, $p < 0.0001$).

The major points arising from this study are that:

1. The Community Fluorosis Index (CFI) for the combined Blue Mountains and Hawkesbury regions was 0.66.
2. Seventy percent of children started brushing their teeth with toothpaste by the age of 2 years.
3. Seventy percent of the children examined had lifelong exposure to fluoridated water.
4. Children using tank water as the domestic source were 50 percent less likely to have fluorosis.
5. Children using fluoride mouthrinses were three times more likely to have fluorosis – 17 percent of these children commenced rinsing before the age of 5 years.

6. None of the children with moderate or severe fluorosis had ever used fluoride tablets, drops, or rinses.

It is concluded that, the higher than expected prevalence and severity of fluorosis was due mainly to the combined risk posed by the fluoridated water and toothpaste, and for a few individuals, contributing risks are exposure to fluoride rinses and tablets.

It is recommended that:

1. Fluoride supplements, in lozenge formulation, should be restricted to individuals known to be at risk of caries in non-fluoridated areas.
2. The use of fluoridated toothpaste should only be used by children younger than age 2 years only if they are known to be at risk of caries, in which case its use has both important curative and preventive effects.
3. The use of fluoridated toothpaste for preventive purposes by children not known to be at risk of caries should not be encouraged until they are aged 2 years, and its use should be strictly managed by parents to observe that:
 - only a low fluoride formulation toothpaste should be dispensed
 - only a parent should dispense the toothpaste
 - only a smear is dispensed
 - the toothpaste is stored out of reach of children
4. Pre-school children should not use fluoride mouthrinse.
5. Health education messages concerning the informed use of fluoride in caries prevention need to be developed and delivered via appropriate channels.
6. Consideration be given to reducing the target fluoride concentration in Sydney water to a level that is consistent with targets elsewhere based on similar climatic conditions.

Table of Contents

Dedication	ii
Acknowledgements	iii
Summary and Recommendations.....	iv
Table of Contents	vi
List of Tables.....	x
List of Abbreviations.....	xii
PART I	1
1. Review of Literature.....	2
1.1 Dental fluorosis	2
1.2 The assessment of dental fluorosis.....	2
1.2.1 Indices for measuring dental fluorosis	2
1.2.1.1 <i>The Community Fluorosis Index, CFI</i>	3
1.2.1.2 <i>The TF Index</i>	4
1.2.1.3 <i>The Tooth Surface Index of Fluorosis, TSIF</i>	5
1.2.1.4 <i>The Fluorosis Risk Index, FRI</i>	5
1.2.1.5 <i>Other systems for assessing enamel opacities</i>	6
1.2.2 Assessment of examiner reliability	6
1.3 Differential diagnosis of dental fluorosis	7
1.4 Mechanism and timing of fluoride effects on developing enamel	7
1.5 Sources contributing to fluoride intake	8
1.5.1 Exposure to fluoride toothpaste.....	11
1.5.2 Exposure to infant formula.....	12
1.6 Dental Fluorosis in Australia.....	13
1.6.1 Central Australia.....	13
1.6.2 Canberra	14
1.6.3 Western Australia	15
1.6.3.1 <i>Decline in dental fluorosis</i>	20
1.6.4 Queensland	21
1.6.5 Northern Territory	21

1.6.6 New South Wales	22
1.6.7 Victoria.....	23
1.6.8 Water fluoridation in Australia.....	24
1.7 Prevalence of dental fluorosis internationally	24
1.7.1 The York Review	26
1.8 Perceptions of dental fluorosis	27
PART II	29
2. Introduction	30
2.1 Water fluoride levels in Australia	30
2.2 Risk of fluorosis	30
2.3 Water fluoridation in the Blue Mountains.....	31
2.4 Baseline survey	31
2.5 Demographic Description of Blue Mountains and Hawkesbury	31
2.6 Purpose of the study	32
2.7 Ethics review	32
3. Material and Methods.....	33
3.1 Target Sample	33
3.2 Sampling.....	33
3.3 Recruitment of sample	34
3.4 Fluoride history	34
3.5 Measurement of fluorosis.....	35
3.6 Clinical Examination.....	35
3.7 Analysis.....	36
3.7.1 Reliability of measurements.....	36
3.7.2 Bivariate analyses.....	36
3.7.3 The assessment of potential explanatory variables	37
4. Results	38
4.1 The sample	38
4.2 Risk factors for fluorosis.....	39
4.2.1 Fluorosis risk from exposure to fluoridated water	40
4.2.2 Fluorosis risk from exposure to fluoride containing toothpaste.....	40
4.2.2.1 <i>Toothbrushing history</i>	40

4.2.2.2 Toothbrushing frequency.....	40
4.2.2.3 Toothpaste type	40
4.2.2.4 Tendency to ingest toothpaste	40
4.2.2.5 Toothbrush size and amount of toothpaste dispensed.....	40
4.2.2.6 Rinsing after toothbrushing.....	51
4.2.3 Fluorosis risk from exposure to fluoride supplements	51
4.2.4 Fluorosis risk from exposure to fluoride gel and rinse.....	51
4.2.5 Fluorosis risk from exposure to use of infant formula	51
4.2.6 Aboriginal and Torres Strait background.....	53
4.2.7 Occupation of Mother	53
4.3 Predictors of fluorosis	53
4.3.1 Logistic regression analyses.....	53
4.3.1.1 Associations with fluorosis prevalence - FLU2 [Ranks dichotomised as 0 (normal + questionable), 1 (very mild + mild + moderate + severe)].....	53
4.3.1.2 Associations with fluorosis prevalence - FLU3 [(Ranks dichotomised as 0 (normal + questionable + very mild), 1 (mild + moderate + severe)].....	58
4.4 Reliability of measurements.....	60
5. Discussion	61
5.1 Fluorosis and water fluoridation	61
5.2 Fluorosis and toothpaste use	63
5.3 Fluorosis and fluoride supplements.....	64
5.4 Fluorosis and fluoride mouthrinse.....	64
5.5 Fluorosis and infant formula use.....	65
5.6 Summary	66
5.7 Recommendations	67
References	68
Appendices	76
Appendix A: Map of Blue Mountains and Hawkesbury.....	77
Appendix B: Ethics approval	79
Appendix C: Information package for school principals	85
Appendix D: Information package for parents.....	87
Appendix E: Questionnaire	92

Appendix F: ABS classification of occupation..... 106

Appendix G: Bivariate analyses tables..... 109

Appendix H: Kappa value calculation tables 171

Appendix I: Russell’s differential diagnosis criteria for fluorosis 176

Appendix J: Photographic examples of Dean Index ranks 178

Supplement..... 179

List of Tables

Table 1: Total children examined.....	38
Table 2: Distribution of children with erupted maxillary central incisors.....	38
Table 3: Community Fluorosis index (CFI) by region.....	39
Table 4: Distribution of Dean fluorosis rank (FLU) and related statistics by potential explanatory variables.....	41
Table 5: Distribution of Dean Index ranks by potential explanatory variable TBSPIT2 (What child does after toothbrushing now).....	52
Table 6: Distribution of Dean Index ranks by potential explanatory variable FRIN (Use of fluoride mouthrinse).....	53
Table 7: Distribution of Dean Index ranks by potential explanatory variable FORMIX (Infant formula reconstituting agent).....	54
Table 8: Distribution of Dean Index ranks by potential explanatory variable ABTS (Child of Aboriginal or Torres Strait Islander origin).....	55
Table 9: Distribution of Dean Index ranks by potential explanatory variable JOBF (Mother/female guardians job).....	56
Table 10: Odds ratios for very mild or more severe fluorosis. Potential explanatory variables were identified in logistic regression analyses as those showing a univariate association ($p<0.2$) with FLU2*. Categories shown in bold are reference categories in relation to odds ratio estimates.....	57

Table 11: Best fitting multiple logistic regression model identified using backward
stepwise variable selection.....58

Table 12: Odds ratios for mild or more severe fluorosis. Potential explanatory
variables were identified in logistic regression analyses as those showing a
univariate association ($p<0.2$) with FLU3*. Categories shown in bold are
reference categories in relation to odds ratio estimates.....59

Table 13: Best fitting multiple logistic regression model identified using backward
stepwise variable selection.....60

List of Abbreviations

ABS	Australian Bureau of Statistics
AHS	Area Health Service
BMCC	Blue Mountains City Council
CFI	Community Fluorosis Index (Dean)
F	Fluoride
g	gram
Kg	Kilogram
L	Litre
LGA	Local Government Area
mg	milligram
NHMRC	National Health and Medical Research Council
NSW	New South Wales
OR	Odds Ratio
ppm	parts per million (1 ppm F = 1 mg/L F)
TF Index	Thylstrup and Fejerskov Index
WHO	World Health Organisation
µg	microgram (1 µg = 10 ⁻⁹ kg)

PART I
REVIEW OF LITERATURE

1. Review of Literature

1.1 Dental fluorosis

Dental fluorosis is a subsurface enamel hypomineralisation or porosity that occurs when there is long-term intake of above optimum amounts of fluoride during dental enamel formation (Fejerskov *et al.*, 1977).

Dental fluorosis has been proven to be caused by high levels of fluoride in drinking water or a combination of fluoridated water with additional fluoride ingestion from fluoride supplements, fluoride toothpaste, and infant formula reconstituted with fluoridated water (Fejerskov *et al.*, 1988).

H. Trendley Dean was the first to describe the relationship between the concentration of fluoride in drinking water and prevalence of dental fluorosis and demonstrated this through extensive epidemiological studies undertaken in USA during the 1930's. He also showed conclusively that the severity of dental fluorosis increased with increasing fluoride concentration in the drinking water. One of his aims was to determine the "minimum threshold" of fluorine, the level of fluoride in drinking water supplies where minimum dental fluorosis occurs while retaining maximum caries protection. In 1937, Dean concluded from his studies that, "amounts not exceeding 1 part per million expressed in terms of fluorine (F) are of no public health significance" (Dean, 1937).

Above optimal intake of fluoride results in changes to the enamel which can be clinically observed as ranging from fine white lines to chalky opaque enamel to severely pitted enamel. The severity of dental fluorosis depends upon the amount of fluoride intake during tooth formation (Fejerskov *et al.*, 1988).

1.2 The assessment of dental fluorosis

1.2.1 Indices for measuring dental fluorosis

A number of indices have been developed over the years to measure and record enamel fluorosis.

1.2.1.1 The Community Fluorosis Index, CFI

This epidemiological index was first developed by Dean in 1934 to help investigate dental fluorosis in population groups (Dean, 1934), and later modified by him in 1942. According to this index each erupted permanent tooth is ranked according to one of six classifications:

- Normal (no observable fluorosis)
- Questionable fluorosis
- Very mild fluorosis
- Mild fluorosis
- Moderate fluorosis
- Severe fluorosis

The individual is classified similarly, based on the two most severely affected teeth in that individual’s mouth.

The occurrence of dental fluorosis in populations is expressed as the CFI. The index is computed by weighting each of the six classifications as shown below:

<i>Classification</i>	<i>Weight</i>
Normal	0
Questionable	0.5
Very mild	1
Mild	2
Moderate	3
Severe	4

The CFI can then be calculated as follows:

$$CFI = \frac{\text{frequency of individual fluorosis classification} \times \text{statistical weight}}{\text{total number of individuals examined}}$$

Dean (1946) determined that a CFI value of 0.0 to 0.4 was of no public health significance, while mean values of 0.4 to 0.6 were associated with borderline public health significance, and that values greater than 0.6 begin to constitute a public health problem warranting increased consideration. This index was developed to assist the comparisons of fluorosis

severity in different populations exposed to naturally occurring fluoride levels in the water supplies.

According to the criteria developed by Dean, a case definition of fluorosis, is when at least two teeth display evidence of very mild or more severe fluorosis, that is, the classification of questionable fluorosis is not regarded as definite fluorosis and therefore not a case definition. Hence, the prevalence of fluorosis refers to the proportion of the community that display very mild or more severe fluorosis.

The merit of the CFI is that fluorosis is recorded when the tooth is visualised in the wet state, and therefore as it naturally appears to observers, including lay observers.

1.2.1.2 The TF Index

Thylstrup and Fejerskov proposed a classification system in 1978 and named it the Thylstrup Fejerskov Index (TF Index). For recording dental fluorosis using this index the teeth are dried with an air blast. The clinical appearance of dental fluorosis is then categorised into ten classes, ranging from a score of 0 to 9, reflecting increasing degrees of severity.

The scores in the TF Index are represented as an ordinal scale and each score is considered an arbitrary point along a continuum of changes in the dental enamel. The scores in the index are designed to characterise the macroscopic degree of dental fluorosis correlated with histological changes. The macroscopic appearances of increasing degrees of dental fluorosis have been shown to be well correlated with the degree of subsurface porosity (Thylstrup and Fejerskov, 1978).

This classification system is more sensitive than Dean's classification, particularly in distinguishing variations in the macroscopic appearance of the more severe degrees of dental fluorosis.

The TF index was developed for matching clinical signs with histological signs of fluorosis. This demands that more detailed clinical measurements are required, and hence the need to dry the tooth surface before a determination of the clinical status. Hence, it is

questioned whether this it is appropriate to use this index for more general epidemiological purposes. This index should not be used for the purpose of commenting on community perspectives of tooth aesthetics, because the descriptions of fluorosis are given in technical terms that are unfamiliar to lay persons, and because such descriptions refer to the dried tooth surface of which lay persons have no concept.

1.2.1.3 The Tooth Surface Index of Fluorosis, TSIF

Horowitz *et al.* (1984) proposed this method of assessing fluorosis prevalence. The index is used to record all surfaces of the teeth that have not been restored. For the anterior teeth the labial and lingual surfaces are scored; and for the posterior teeth the buccal, lingual, and occlusal surfaces are scored. Teeth that are fully erupted only are scored using this index.

The teeth scored are given values ranging from 0 to 7, which shows an increase in severity of fluorosis with increasing score. There is no “questionable” category in this index and it is designed to improve sensitivity when applied in populations with more severe fluorosis. In cases where more than one form of fluorosis is seen on the same surface, the higher score is assigned.

The TSIF index is very similar to that of developed by Dean. The questionable category in Dean is, in the TSIF index, considered to be a definite sign of fluorosis. Scores are given to the buccal and lingual surfaces of all teeth, whereas, with the Dean index, classically all teeth are inspected, but only one rank is assigned to the case, based on the severest score affecting at least two teeth. The same information, as recorded using the TSIF index, could also be recorded (and sometimes is) based on Dean's criteria.

1.2.1.4 The Fluorosis Risk Index, FRI

Pendrys (1990) proposed this index to identify accurately the association between age related fluoride exposure and the development of dental fluorosis.

The enamel surface zones of teeth, according to this index, are designated as classification I (enamel surface zones formed during first year of life) and classification II (enamel surface zones formed between the third and sixth year of life).

The identification of fluorosed enamel is done using Dean's and Møller's criteria. The enamel surface zones are scored negative for fluorosis, questionable for fluorosis, positive for mild to moderate fluorosis, or positive for severe fluorosis (scores 0 to 3). Nonfluoride opacities are scored as 7, and surface zones excluded from classification are scored as 9.

The fluorosis risk index was developed specifically for assessing the chronological development of fluorosis during embryological growth of certain teeth. It is to be used only in special circumstances and not in general surveys of oral health.

1.2.1.5 Other systems for assessing enamel opacities

The enamel opacities of dental fluorosis have also been classified according to general systems for categorising a range of enamel defects, such as that developed by Al-Alousi *et al.* (1975) and that by the FDI Commission on Oral Health, Research, and Epidemiology [the Developmental Defects of Enamel Index (DDE Index)] (Ainamo and Cutress, 1982).

Evans (1995) reviewed these systems and stated: "Because of the generality inherent in these systems, it is inappropriate to use them for the specific purpose of investigating the prevalence or severity of dental fluorosis. A specific drawback of the DDE Index is that missing enamel and pits are classified as hypoplasia. Yet the pits which characterise severe dental fluorosis are not hypoplastic in origin - they develop posteruptively. Pits of hypoplastic origin are often more frequently found in non-endemic areas and may not therefore be differentiated from those of dental fluorosis by this index. When the FDI system is used in this way, the outcome will inevitably lack precision ...".

1.2.2 Assessment of examiner reliability

Kumar *et al.* (2000) reported on the interexaminer reliability using Dean's Index for dental fluorosis. Field examinations were conducted on 3,326 children from grades one to eight. Three examiners were trained in fluorosis evaluation by using colour transparencies and by discussing dental fluorosis cases at a study site. The unweighted kappa values ranged from 0.67 to 0.76, and weighted kappa values exceeded 0.76 when the units of observation were subjects. When teeth were taken as the units of observation, the kappa values reduced and ranged from 0.52 to 0.65 for the unweighted kappa and 0.59 to 0.75 for the weighted kappa. The interexaminer reliability using Dean's Index was found to be excellent when

presence or absence of fluorosis was made and differences noted among examiners were not great in most cases. It was recommended that weighted analysis was more meaningful in prevalence studies and unweighted analysis in studies where disagreements about severity were important.

1.3 Differential diagnosis of dental fluorosis

Epidemiological studies have made it necessary to differentiate between fluorotic and non-fluorotic defects of the dental enamel as a diagnostic base for dental fluorosis (Cutress and Suckling, 1990). It was noted that in diagnosing fluorosis, confidence increased with increasing severity of enamel defects and that problems increased with lesser severity. Previously, the recommendations for differential diagnosis of fluorosis were confined to differentiating between symmetrical (meaning that signs are distributed equally on contralateral teeth) and asymmetrical and/or discrete patterns of opaque defects. The reviewing authors had recommended the following procedure for differential diagnosis of dental fluorosis. The teeth are examined for the presence of defects in the enamel. If a defect is observed then it has to be ascertained if the defect is an opacity or not. If an opacity, it has to be seen whether the opacity is symmetrical or asymmetrical. On confirmation of a symmetrical opacity in the dental enamel, a diagnosis for the presence of dental fluorosis can be made if there is evidence of an endemic prevalence of the condition and above-optimal fluoride in the drinking water. If the condition is observed in non-endemic areas then other sources of fluoride ingestion must be investigated. The authors concluded on the note that if no evidence of excessive fluoride ingestion was found then the condition should not be diagnosed as fluorosis.

1.4 Mechanism and timing of fluoride effects on developing enamel

Evans and Stamm (1991a) conducted investigations to determine when, during their development, maxillary central incisors are susceptible to fluorosis from exposure to a fluoride challenge. The fluoride concentration of the water supplies of Hong Kong was adjusted downwards from 0.8 to 0.6 ppm in June 1978. The children examined in 1986 were aged 7 to 12 years and were grouped into birth cohorts. The focus of analysis was on the cohorts of 1975, 1976 and 1977. A total of 576 children belonged to the three cohorts. The fluorosis status of the maxillary central incisors was evaluated for the assessment of susceptibility of enamel to fluorosis. It was found that the maxillary central incisors were

most susceptible to fluorosis during a “four month period commencing at around 22 months from birth”. Since the development of the central incisor commences at birth and is about half formed at 22 months of age, it was concluded that dental fluorosis is an enamel maturation defect.

Den Besten (1999) reviewed several studies related to the exposure of higher than optimal fluoride levels during enamel development. One of the studies referred to a village in Japan where the level of fluoride in the water supplies was adjusted from 7.8 ppm down to 0.2 ppm (Ishii and Suckling, 1986). The age of the children at the time of fluoride adjustment ranged from 11 to 42 months. The appearance of the enamel was recorded 11 years later using Dean’s Index when children were aged 12 to 15 years. It was noted that children aged 35 to 42 months at the changeover had moderate to severe fluorosis of the left maxillary central incisor whereas children aged 11 to 33 months had either very mild or questionable fluorosis or had no fluorosis. The review concluded that enamel fluorosis occurred during the early maturation stage of enamel formation.

1.5 Sources contributing to fluoride intake

Whitford (1996) reported that the amount of fluoride intake needed to induce a degree of dental fluorosis ranged from 0.75 to 1.0 mg/day. If diet were the only source of fluoride, then the intake of fluoride was estimated to be 0.5 mg/day. Toothbrushing once a day with 1.0 g of toothpaste would increase the daily intake of fluoride by about 50 percent, and if brushing of teeth were carried out twice a day then the fluoride intake would be doubled to 1.0 mg/day. Similarly, rinsing with a 0.05 percent sodium fluoride solution and/or ingesting fluoride tablets would add 0.25 mg F/day if taken once a day and 0.5 mg F/day if taken twice a day. The levels of fluoride intake would thus add up to 2.0 mg/day and produce more than the mild types of dental fluorosis. When taking these high levels of fluoride intake into consideration, the prevalence of dental fluorosis is more severe than can be predicted only on the basis of intake of fluoride from food and water.

In a review carried out by the National Health and Medical Research Council (NHMRC, 1991), the daily intake of fluoride for 2-year-old children living in areas with 1.0 ppm, 0.5 ppm and 0.15 ppm of fluoridated water was calculated. Children aged 2 years were selected as they were more likely, at that age, to have “maximum intake of fluoride per

kilogram of body weight". It was found that a major part of the daily fluoride intake was from toothpaste (0.5 mg), and was the same for the three areas. The daily intake of fluoride from food was also found to be similar for children in the three areas (about 0.3 mg). However, the intake of fluoride from water and beverage consumption differed in the three areas, and was about 0.3 mg/day for areas with 1.0 ppm F in water, nearly 0.2 mg/day for areas with 0.5 ppm F in water and <0.1 mg/day for areas with 0.15 ppm F in water. The values presented were estimates for the three areas and were based on information taken from several studies.

Levy *et al.* (1995) reported that studies in recent years have shown beverages, juices and baby foods to constitute the majority of an infant's diet, and water by itself was consumed only in small proportions. The study was carried out in Iowa City, Iowa and the total intake of water by infants (including tap, bottled and/or filtered water) was used to estimate the total fluoride intake and then compared with recommended optimal levels of fluoride intake. Information regarding fluoride was obtained through questionnaires completed by the mothers and through fluoride assays of the water supplies of the homes and child-care centres of the infants. Parental reports on dietary intake, for the same cohort followed from birth, were collected at 6 weeks (124 subjects), 3 months (120 subjects), 6 months (99 subjects) and 9 months (77 subjects). The estimates to calculate the fluoride intake were derived from water alone and water added during food preparation, and did not consider other dietary and non-dietary sources of fluoride. The daily fluoride intake was calculated only on the basis of the amount of water ingested. Results showed that water by itself was not the primary source of fluoride for infants, as about 35 to 70 percent of children aged between 6 weeks and 9 months did not ingest water by itself. The range of fluoride intake from all sources was 0-1.24 mg/day at 6 weeks, 0-1.57 mg/day at 3 months, 0-1.29 mg/day at 6 months and 0-1.73 mg/day at 9 months. It was found that 10 percent of infants in each age group exceeded the "optimal" (0.05 to 0.07 mg F/kg body weight) daily intake of fluoride considerably. From the 75th percentile on, this excess intake of fluoride was noted for all ages except at age 9 months.

In New Zealand, Chowdhury *et al.* (1990) studied the fluoride intake of infants aged 11 to 13 months and compared the fluoride intake of infants in fluoridated and non-fluoridated areas. Parents of 60 infants took part in the survey and provided duplicate portions of food

and drinks consumed by the infants during a three day period. The food and drinks were duplicated by visual assessment both quantitatively and qualitatively. A sample of breast milk was obtained from mothers who were nursing their infants. Samples of fluoride tablets and equivalent amount of toothpaste normally used by the infants were also collected. The fluoride content of breast milk of mothers living in fluoridated and non-fluoridated areas was not statistically different ($p > 0.05$, t test). The mean fluoride intake of fluoride from breast milk was estimated to be 0.003 mg/day. The fluoride content of food samples in the fluoridated area ranged from 0.130 to 0.679 mg F/kg of food and in non-fluoridated area ranged from 0.036 to 0.281 mg F/kg of food. Hence, the mean fluoride content from food and drinks of the infants in fluoridated areas was 3.4 times greater than the mean intake of infants in non-fluoridated areas. The fluoride intake from toothpaste was calculated on the assumption that 80 percent of the paste was swallowed by the infants during brushing. The toothpaste ingestion was observed to increase the total fluoride intake of infants in non-fluoridated areas to near optimal levels (0.05-0.07 mg F/kg body weight), and caused the fluoride intake to exceed optimal levels in fluoridated areas. The mean fluoride intake of infants using fluoride tablets (at 0.25 mg/day) in non-fluoridated areas was found to be either similar or slightly lower than the mean fluoride intake of infants in the fluoridated areas. Dietary sources, having high fluoride content, such as soy-milk formula and tea were found to raise the daily fluoride intake to near optimal levels in non-fluoridated areas. On the basis of these findings the authors suggested that, "if a child on soy formula in the non-fluoridated were to ingest fluoride supplements and large amounts of toothpaste as well, the total fluoride intake of this infant could exceed optimal levels of intake". The authors concluded that the level of fluoride intake from food and drinks alone did not exceed the recommended optimal level and stressed that potential high fluoride dietary sources should be identified before recommending fluoride supplements.

Rojas-Sanchez *et al.* (1999) investigated the daily intake of fluoride by young children from diet and dentifrice in negligibly and optimally fluoridated areas. A total of 54 children aged between 16 and 40 months participated in the study. The children were from three regions and were divided into three groups, each belonging to one region. There were 11 children in San Juan, Puerto Rico (water fluoride ≤ 0.3 mg/L F. Note, no water fluoridation in all of Puerto Rico); 14 children in Connorsville, Indiana (water fluoride ≤ 0.3 mg/L F.

Note, majority of urban and rural populations in Indiana receive fluoridated water); and 29 children in Indianapolis, Indiana (water fluoride 0.8-1.2 mg/L F). A questionnaire was filled by the parents regarding toothbrushing history. Duplicate meals, snacks and beverages were collected for each child. Parents were also asked to brush the teeth of the children and dentifrice use was measured by noting the amount of toothpaste put on the brush and the amount expectorated after brushing. Residual toothpaste was also collected from the toothbrush by rinsing with deionised water. Water samples from homes and day care centres of the children were also analysed for fluoride content. The amount of fluoride ingested from food alone was not significantly different in the three communities. However, intake of fluoride from beverages differed significantly, with children in Indianapolis ingesting 0.40 mg/day, children in Connersville ingesting 0.26 mg/day and children in San Juan ingesting 0.10 mg/day. The reason for the higher ingestion of fluoride from beverages in Connersville was attributed to the “so-called halo effect”. This effect refers to the fact that although Connersville is not fluoridated, residents there consume beverages and foods processed in other fluoridated areas and are therefore exposed to fluoride derived from surrounding fluoridated environments. Every child in the study used fluoridated toothpaste. The amount of fluoride ingestion from toothpaste was not significantly different for children in San Juan and Connersville (0.76 and 0.96 mg F/day respectively) whereas it was significantly less for children in Indianapolis (0.42 mg F/day). Combined daily ingestion of fluoride from beverages and toothpaste was not found to be significantly different in the three communities. It was found that a significant proportion of the combined daily intake of fluoride for the children in all three regions was from toothpaste. Also, a high percentage of children from Connersville (57 percent) and Indianapolis (45 percent) ingested more than 0.07 mg F/kg/day (considered the upper estimated threshold limit). The study did not take into consideration use of fluoride supplements, mouthrinses or gels.

1.5.1 Exposure to fluoride toothpaste

Mascarenhas and Burt (1998) conducted a study in Goa, India to determine risk factors for dental fluorosis in a non-fluoridated area. A total of 1,250 students from 11 of the more affluent schools were examined. The mean age of the children was 12.2 years. History of fluoride toothpaste use and brushing habits was obtained from questionnaires completed by parents. Dental fluorosis was recorded using the TF Index. The water supplies of Goa have

never been fluoridated and the level of fluoride in water ranges from 0.05 to 0.1 mg/L F. The prevalence of fluorosis was observed to be 0.13. It was observed that among children who had fluorosis, the children who had started brushing before the age of 2 years had “significantly higher severity of fluorosis” ($p < 0.001$). The authors concluded that fluoride toothpaste use before 6 years of age was a risk indicator for fluorosis (OR 1.8).

In another study, the amount of fluoride ingested from toothpaste was determined by Bentley *et al.* (1999). A total of 50 children aged 2.6 years were selected randomly from three districts in the North West Region of England. The homes of the children were visited and the parents were asked about the brushing habits of the children. The children were weighed on household scales. The parents were provided with a new toothbrush and a weighed tube of toothpaste, and were then asked to brush the children’s teeth in the usual manner. The amount of fluoride retained on the toothbrush and in the rinsing fluids was measured. The mean amount of toothpaste used was 0.36 g (range 0.09 to 1.0 g) and the mean amount of toothpaste ingested per brushing was 0.27 g (range 0.04 to 0.83g). The mean weight of the children was 14.2 kg (range 10.8 to 18.0 kg). The amount of fluoride ingested depended on the type of toothpaste used by the children. The mean daily dose of fluoride ingested for children using the family toothpaste was 0.06 mg F/kg (range 0.007 to 0.14) and for those using children’s toothpaste was 0.01 mg F/kg (range 0.002 to 0.05). It was observed that on an average “72 percent of the toothpaste applied to the toothbrush was retained in the mouth and presumably ingested”. It was found that the higher the concentration of fluoride in the toothpaste of the children the greater is the risk of the child to dental fluorosis.

1.5.2 Exposure to infant formula

Fluoride in infant formula has been implicated as a risk factor for dental fluorosis in a number of studies (Silva and Reynolds, 1996). In their study, the fluoride content of the commonly used infant formulae in Australia was measured. The major source of fluoride in infancy was considered by the authors to be infant formulae. The eleven most commonly used infant formulae were selected and analysed using the microdiffusion method. For milk based formulae, the fluoride content was found to range from 0.23 µg F/g powder to 3.71 µg F/g and the fluoride content of the soy-based formulae ranged from 1.08 µg F/g powder to 2.86 µg F/g. The known addition of fluoride recovered for each sample was 92

to 100 percent. The infant formulae were analysed again after being reconstituted, according to the manufacturer's instructions, using water containing 0, 0.1 and 1.0 ppm fluoride. None of the formulae reconstituted in 0.1 ppm fluoride water provided a daily intake of fluoride greater than the suggested limit of 0.01 mg F/kg body mass/day at any age. However, all the formulae when reconstituted in 1.0 ppm fluoride water provided a daily fluoride intake of two to three times the recommended upper limit of 0.07 mg F/kg body mass/day. It was observed that infant formula reconstituted with 0 and 0.1 ppm fluoridated water was unlikely to be a risk factor for dental fluorosis. However, the authors suggested that prolonged consumption of infant formula reconstituted with optimally fluoridated water (1.0 ppm F) might be a risk factor for the development of dental fluorosis of the anterior permanent teeth.

In a similar study in Brazil, Buzalaf *et al.* (2001) investigated the fluoride content of reconstituted infant formulas using fluoridated, deionised and bottled mineral water. Ten samples of infant formulas available commercially in Brazil were used in the study. The infant formulas were reconstituted according to the manufacturer's instructions. The fluoride concentration of the fluoridated water was 0.9 ppm, and of the bottled water ranged from 0.02 to 0.69 ppm. The powdered infant formulas had fluoride content ranging from 0.01 to 1.65 ppm. The fluoride concentration of reconstituted infant formulas ranged from 0.01 to 0.75 ppm with deionised water, from 0.91 to 1.65 with fluoridated water and from 0.02 to 1.37 with bottled mineral water. The infant formula samples were found to exceed the optimal daily intake of fluoride and almost all samples provided a daily intake of fluoride above the suggested threshold of 0.1 mg F/kg for fluorosis. The study concluded that in order to limit fluoride intake to <0.1 mg/kg/day, the use of fluoridated water (around 1 ppm) to reconstitute infant formula was to be avoided.

1.6 Dental Fluorosis in Australia

1.6.1 Central Australia

In 1956, Barrett published observations made on a group of Australian Aborigines in the Yuendumu Native Settlement of Central Australia. The water supplies of "the natives" at Yuendumu were obtained from the settlement bores and, on their occasional journeys, from natural water sources. The average fluoride content of eleven samples of Yuendumu

Settlement bore water was 1.5 ppm, ranging from 1.3 to 1.8 ppm. The fluoride content of water samples obtained from other sources ranged from 0.0 ppm to 0.4 ppm. Dean's index was used to record the occurrence of fluorosed enamel at the settlement. Fluorosed enamel was noted in the permanent teeth of approximately 30 percent of subjects aged from 6 to 20 years. A total of 158 people were examined. Most of the cases were recorded as 'very mild' (36), a few as 'mild' (8) and one as 'moderate'. The mean annual temperature of Yuendumu is 21° C, the average annual evaporation is 97 inches and the average relative humidity is 38 percent. It was observed that the native children consumed more water than the white children at the settlement. The settlement had been established for a relatively short time (10 years) and the frequency of occurrence of enamel defects, recorded as fluorosed enamel, was not a true measure of continuous use of Yuendumu bore water. It was observed that there would be a greater likelihood of the occurrence of fluorosed enamel in future years when more children would have been exposed to water containing excess fluoride during the enamel formative period. In this study enamel hypoplasia was frequently seen in deciduous teeth. A general impression was formed that enamel hypoplasia was becoming more frequent and that lesions seen in 1955 were more severe than those seen in 1951. It was reported that consideration needed to be given to the need for appropriate filtration of the Yuendumu water supply.

1.6.2 Canberra

Canberra's domestic water supply was fluoridated on September 9, 1964 (Carr, 1966). This study of the effects of fluoridation was confined to children living in Canberra. A pre-fluoridation survey was carried out in 1964, prior to fluoridation, to study the prevalence of mottling of teeth and gross hypoplasia of the enamel. The investigation was divided into three main sections dealing with opacities and hypoplasia of enamel, dental caries and aspects of occlusion. The age of children investigated ranged from 5 to 12 years. The presence and degree of enamel fluorosis and hypoplasia was recorded for the permanent teeth. The classification and criteria for diagnosis, in increasing severity, was as follows: *Normal* – no visible mottling or hypoplasia. *Questionable* – examiner uncertain of presence of fluorosis, referred to as mottling. *White mottling* – whitish or pale-yellowish areas of mottling, smooth enamel surface. *Brown mottling* – brownish or yellow-brown areas of mottling, smooth enamel surface. *Gross hypoplasia* – rough corroded enamel surface, pits and/or grooves affecting contour and shape of enamel. The dentition was examined as a

whole and also divided into anterior, canine to canine, and posterior sections. The most severely affected tooth from these sections was classified for each individual. White mottling was observed in 28.1 percent of 6-year-olds, 34.5 percent of 9-year-olds and 27.2 percent of 12-year-olds. Brown mottling was observed in 2.4 percent of the 6-year-olds, 7.6 percent of the 9-year-olds and 14.6 percent of the 12-year-olds. Hypoplasia (unrelated to fluorosis) was observed in 1.8 percent of the 6-year-olds, 4.1 percent of the 9-year-olds and 9.6 percent of the 12-year-olds. The author concluded that 42.2 percent of 7-year-old and 53.4 percent of the 12-year-old children had mottled enamel.

1.6.3 Western Australia

Kailis and Silva (1967) reported on 496 Caucasian children aged 6 to 16 years who were examined in Carnarvon, Western Australia. Dean's classification was used to record the severity of the defects in enamel. The fluoride content of the sub-artesian bore used before 1958 was 0.4 ppm, and after 1958 the water for the community was obtained from a new source that contained 1.5 ppm fluoride. Dental fluorosis was observed in the permanent teeth of 225 or 45 percent of the children examined. Of the total children examined, 17 children (3.4 percent) exhibited questionable fluorosis, 92 (18.5 percent) had very mild fluorosis, 95 (19.2 percent) had mild fluorosis and 21 (4.2 percent) of the children had moderate fluorosis. The fluorosis status of the Carnarvon children was 0.71 according to the CFI. Carnarvon has a mean maximum annual temperature of 27° C and the mean minimum average annual temperature is 17° C. It experiences 85 inches of evaporation per year and has an average relative humidity of 63 percent. Kailis concluded that these climatic conditions were conducive to an increased liquid intake and would increase the amount of fluoride ingested per child. The change in the communal water supply in Carnarvon appeared to have brought about endemic dental fluorosis.

Later, Kailis and Silva (1970a) reported more details on the Carnarvon study. They investigated further the causes and prevalence of dental fluorosis in the area. In 1963 it was observed that 225 out of 496 (45.4 percent) school children exhibited dental fluorosis. This was attributed to the fluoride concentration of the Carnarvon water supplies that varied from 0.2 ppm to 2.0 ppm, where the fluoride concentration of the town water supply was 1.5 ppm and the average plantation bore water was 0.7 ppm. As many of the children resided on plantations and attended schools in town, the report examined whether any

significant differences in dental fluorosis occurred between the residents of the two areas. The 496 children were divided into residents and migrants according to age and sex. Residents were classified as children born and residing continuously in Carnarvon, and migrants as children born outside Carnarvon but resident at the time of the examination. The children were further divided into four groups, whether they resided in town or on plantations. The groups of children were as follows: town resident, town migrant, plantation resident and plantation migrant children. It was observed that the town children were more markedly affected than the plantation children. The CFI values for the four groups were as follows: town residents 1.03, plantation residents 1.13 (small number of subjects), town migrants 0.53, and plantation migrants 0.37. Combined residents gave a CFI of 1.06 and combined migrants 0.45; the combined index for the entire population was 0.71. The regression analysis of the period of residence demonstrated a highly significant correlation with fluorosis ($r=0.432$, $p<0.001$). The multiple regression analyses of fluorosis on age and period of residence was reported to be highly significant. There were 21 children with moderate fluorosis and it was observed that lower incisors were the least affected by fluorosis. The fluorosis results demonstrated to the authors that the teeth were exposed to higher than the optimum concentration required for caries reduction.

Kailis and Silva (1970b) extended this analysis to Aboriginal children in order to compare prevalence of fluorosis between full blooded and part-European Aboriginal children, and then to compare the two groups with Caucasian children in the same area. In total 172 Aboriginal children aged 6 to 16 years were examined. Dean's classification was used to record dental fluorosis and colour photographs were taken of the teeth. The children resided either in Carnarvon or on a mission situated four miles from the school. The 172 Aboriginal children comprised of 77 full blooded and 95 part-European children, and were further classified into residents or migrants. The Aboriginal children rejoined their parents during school holidays and were apt to travel to different sites. The "blood caste" of children was obtained from teachers and by means of a questionnaire. The migrant children were drawn from as far as 600 miles in the north and 300 miles south-east of Carnarvon. The children had been exposed to a variety of environmental changes, namely climate and water sources. The fluoride concentration in the various water sources ranged from 0.1 ppm to 1.7 ppm. The mean maximum temperature in this area varies from 25° C to 34° C, the mean annual temperature ranges from 20° C to 28° C and the relative humidity ranges

from 36 to 65. All children residing at Carnarvon and attending school there were exposed to water supply containing 1.5 ppm fluoride. The children at the mission were exposed to 0.4 ppm fluoride in the water supply. Dental fluorosis was present in 16 of the 17 town children and 16 of the 17 mission children of the resident group, and in all 3 town children, and in 42 of the 58 mission children of the migrant group. In the resident group, 82.8 percent of the full blood and 93.8 percent of the part-European had dental fluorosis. In the migrant group, the percentage occurrence for dental fluorosis was 79.2 and 73.8 for full blood and part-European-Aborigine children respectively. Comparing the Aboriginal children, 80.5 percent of the full blood and 81.1 percent of the part-European Aboriginal children were affected by dental fluorosis. More Aboriginal children (80.8 percent) had dental fluorosis as opposed to 45.4 percent of Caucasian children. The CFI value was 1.67 for the Aborigines and 0.71 for the Caucasians. The Caucasian group was exposed to a known water supply whereas the Aborigines, especially the migrants, originated from distant areas and were thus exposed to varying fluoride concentrations. No definite explanation for the difference between the groups could be arrived at. However, the authors considered that factors such as variable fluoride ingestion and climatic conditions could have influenced the occurrence and severity of dental fluorosis in this region.

Kailis (1971) reported the dental conditions of Australian Aboriginal children resident in Warburton and Cundeelee missions of Western Australia. This report was part of continuing epidemiological studies carried out to observe dental conditions in Aboriginal children in Warburton and Cundeelee missions in Western Australia. The Warburton Range mission is situated 900 miles north north-east of Perth and Cundeelee is situated 500 miles east of Perth. Children below 6 years were not included in the survey. There were 108 Aboriginal children at the Warburton mission and 39 at the Cundeelee mission. On the basis of information provided by the school, children were divided into those born on the mission (residents) and those brought in from other areas (migrants). Dean's index was used to record the prevalence of dental fluorosis and colour photographs were taken of all dentitions demonstrating fluorosis. Water supplies on the Warburton reserve contained 1.5 ppm fluoride and in the Warburton mission water supplies contained 1.0 ppm fluoride; both areas were supplied by bore water. Cundeelee mission relied on rain water and on water transported to the mission by railroad. Both the water sources contained less than 0.1 ppm fluoride. In 1971, the climate at Warburton had a mean annual maximum temperature

of 29° C, a mean annual minimum temperature of 14° C and a relative humidity between 20 and 34. The climate at Cundeelee had a mean maximum annual temperature of 26° C, a mean minimum annual temperature of 12° C and a relative humidity between 48 and 58. More dental fluorosis was observed in the permanent dentitions of the Warburton children than the Cundeelee children. Kailis observed that 43.5 percent of the Warburton children and 15.4 percent of the Cundeelee children showed dental fluorosis. In Warburton the fluorosis ranged from questionable to moderate and in Cundeelee it ranged from questionable to very mild. The CFI was found to be 0.71 for the Warburton children and 0.16 for the Cundeelee children.

In 1975, Medcalf published findings on six years of water fluoridation in the goldfields of Western Australia. The water supply to the residents of the Western Australian goldfields before 1968 was from a dam and the water contained 0.1 to 0.2 mg/L of fluoride. After 1968 the water supply to the goldfields was fluoridated to a level of 0.7 ppm during the summer months (October to March) and 0.9 ppm from April to September. This study was carried out to assess the effect of six years of fluoridation of the goldfields' water supply on the dental health of selected age groups of school children. A total of 601 children aged 6 years to 10 years were examined. Dean's index of classification was used to record dental fluorosis. A total of 21 children had either questionable or very mild fluorosis. No cases of unacceptable dental fluorosis were seen.

More recently Riordan and Banks (1991) investigated dental fluorosis and fluoride exposure in Western Australia. The aim of the study was to measure dental fluorosis in 12-year-olds in fluoridated and non-fluoridated areas of Western Australia. The sampling units taken were the school dental clinics located in Perth (0.8 mg/L F) and the Bunbury area (F<0.2 mg/L). Questionnaires were used to obtain information related to residence in fluoridated areas, type of water supply, use of fluoride supplements, age at which toothpaste use commenced, and whether the child liked or swallowed toothpaste. Residence from birth to 4 years was categorised as: short, <1 year; medium, 1-2.4 years; and long, 2.5-4 years. The labial surface of each upper left central incisor was scored according to the TF index. If the upper left central incisor was not available for classification, the upper right central incisor was used. In Perth 338 children (163 girls and 175 boys) were examined, they had a mean age of 11 years and 7 months. In Bunbury 321

children (151 girls and 170 boys) were examined and had a mean age of 11 years and 10 months. In total 399 children (60.5 percent) were “long” residents of fluoridated areas and a further 44 (6.7 percent) had some exposure to fluoridated water while aged under four years. Of these 443 children, only 79 children (17.8 percent) reportedly used fluoride supplements. The mean age at which toothbrushing commenced was 1.8 years. Toothpaste was reported to be liked by 545 children (86.6 percent) and 303 (49.1 percent) swallowed it. The children who liked toothpaste and who swallowed it started toothbrushing at a younger age as compared with children who did not. The overall dental fluorosis prevalence was found to be 0.37 (242 persons). In Perth it was 0.40 (136 persons) and in Bunbury area it was 0.33 (106 persons). Although the data suggested that fluorosis was more severe in Perth, this difference was not statistically significant. However, a strong relationship was found between total fluoride exposure and TF score; higher TF scores were associated with higher exposure levels. The prevalence of fluorosis was recorded at 0.45 for participants exposed to fluoridated water from birth to 4 years of age. The study concluded that extended use of fluoride supplements and optimally fluoridated water was a risk factor for dental fluorosis.

In a later study, Riordan (1993a) reported on dental fluorosis, dental caries and fluoride exposure among 7-year-olds. The aim of this study was to record the age of weaning and also the exposure to fluoride from water, toothpaste and supplements. This study was carried out in Perth, Western Australia. Information regarding residence from birth, age of weaning, and use of fluoride supplements and toothpastes was obtained through questionnaires sent to the parents. A total of 350 children (165 girls and 185 boys) with a mean age of 7 years and 6 months were examined. The majority of children examined (311 or 88.9 percent) had lived at least 2.5 years in a fluoridated area between birth and 4 years of age. Most of these children (266 or 76.2 percent) had been breast fed and their mean age of weaning was 7.7 months. Fluoride supplements were used by only 16 children (4.6 percent). Toothpaste was reported to be liked by 297 children (85.3 percent) and was swallowed by 204 children (60.7 percent). The mean age of starting toothpaste use was 1.5 years. The prevalence of dental fluorosis was found to be 0.48 and was higher in those who had lived for a longer period in fluoridated area between birth and 4 years. Fluoride exposure by (a) residence (OR 4.9), (b) reported swallowing of toothpaste (OR 1.7), (c) liking toothpaste (OR 2.6) and (d) being weaned before 9 months of age (OR 1.81) were

found to be statistically significant risk factors for dental fluorosis (TF score ≥ 1). Statistically significant risk factors for severe fluorosis (TF score ≥ 2) were reported to be swallowing of toothpaste (OR 2.64) and weaning less than 9 months of age (OR 2.77). These findings of relatively high prevalence of fluorosis in this study lent urgency to the recommendation of the NHMRC of Australia to better understand the effects of water fluoridation and other sources of fluoride. Also, the study concluded that major non-water sources of fluoride should be eliminated so that the prevalence and severity of dental fluorosis could be minimised.

1.6.3.1 Decline in dental fluorosis

Studies carried out in Western Australia in 1991 and 1993 prompted considerations to help reduce the impact of systemic fluoride ingestion (Riordan, 2002). The School Dental Services in Western Australia started discouraging the use of fluoride supplements and offered advice on toothpaste use. The purpose of the 2002 study was to evaluate the effect of changes made in schedules for discretionary fluoride intake and to measure the prevalence of dental fluorosis and dental caries. The study followed the same protocol that had previously been used in 1989/90. Schools in Perth (fluoridated) and Bunbury area (non-fluoridated) were selected. Background information on residence from birth, drinking water sources, fluoride supplement use, use of infant formula and toothpaste use were obtained from questionnaires sent to the parents. Residence in the period from birth to five years of age was categorised as 'F' if more than half the period had been spent in a fluoridated area, and 'Non-F' if not. Dental fluorosis was scored using the TF index. In total, 582 children (283 girls and 299 boys) were examined and the mean age of the participants was 10 years. Of the total, 375 children (64.4 percent) had lived for more than 2.5 years of their first four years in a fluoridated area. By 12 months of age, 336 children (57.7 percent) were reported to have used infant formula. Of the total, 287 children (49.5 percent) commenced toothbrushing before 1.5 years of age and 244 children (41.9 percent) commenced after 1.5 years. Fluoride supplements were reportedly used by 40 children (6.9 percent). Overall, the prevalence of fluorosis among the children was found to be 0.18. The prevalence of fluorosis among children in fluoridated area was 0.20 and among children in a non-fluoridated area it was 0.15. Children resident from birth to 4 years in a fluoridated area were more likely to have some fluorosis than children resident in a non-fluoridated area and this difference was statistically significant ($p < 0.05$). Bivariate and multivariate

analysis showed statistical significance only for residence in a fluoridated area from birth to 4 years of age. The principal finding of this study was the observed reduction in the prevalence of fluorosis as compared to the prevalence in the 12-year-olds of the previous study; the prevalence of fluorosis was 0.18 as against 0.37 previously. These findings suggested that dental fluorosis could be brought under control by eliminating fluoride intake from fluoride supplements and fluoride toothpastes.

1.6.4 Queensland

Davies *et al.* (1969) surveyed children in country districts of Queensland. The aim of the study was to obtain data that would serve as a basis for an evaluation of the existing dental services in Queensland. A total of 3,251 children in 20 towns were examined and the towns were selected so as to be representative of the country districts of Queensland. The children were aged 6, 8, 10, 12 and 14 years, and approximately equal numbers of girls and boys in each age group were examined. Examination for dental fluorosis was one of the several objectives of the study. Dean's index was used to record enamel fluorosis. Children who had questionable, very mild or mild fluorosis totalled 419 (12.8 percent) and 19 children (0.6 percent) showed mild, moderate or severe fluorosis. Four towns having high level of fluoride in the town water supply had higher prevalence of enamel fluorosis. These towns had water supplied to them from artesian bores.

1.6.5 Northern Territory

Williamson and Barrett (1972) investigated the prevalence of clinically observable dental fluorosis in Australian Aborigines in Yuendumu in the Northern Territory. The results were compared with earlier studies carried out in Yuendumu in 1953 and 1956. A total of 163 males and 146 females were examined; their ages ranged from about four to twenty four years. Subjects were grouped according to their chronological age and also into five groups determined by the tooth eruption status – infants, juveniles 1, juveniles 2, adolescents and adults. Dean's index was used to record the dental fluorosis prevalence and CFI was calculated for each of the groups. Findings for the groups: juveniles 2, adolescents, and adults were reported. More than 50 percent of all subjects were found to have a fluorosis score of "mild" or worse, but fewer than 35 percent had a fluorosis score of "moderate" or worse. This corresponded with a CFI of "medium". Also, more than 90 percent of the 1970 study sample showed a fluorosis score of "very mild" or worse as

compared to 30 percent of the 1955 study sample. This comparison demonstrated that the prevalence of dental fluorosis had markedly increased from 1955 to 1970. The water supplies between 1955 and 1965 had a fluoride content ranging from 1.3 ppm to 1.8 ppm. However, since 1965 a different bore was used and a consistent fluoride content of 0.4 ppm was reported. With the reduced fluoride concentration in the water supply of Yuendumu, it was anticipated that dental fluorosis would be less severe when the effects could be observed next. The results suggested that Aboriginal children maybe drinking more water than the European children.

1.6.6 New South Wales

A baseline dental examination was carried out in Tamworth, NSW in May-June of 1963 before the introduction of water fluoridation in October 1963 (Barnard, 1995). Follow-up surveys were carried out annually to 1973, then in 1979 and in 1988 by the same team to evaluate the changes in the dental health of school children in Tamworth and to observe the levels of fluorosis. All schools in Tamworth were included in the dental surveys and all children who returned parental consent forms were examined. A total of 62,908 children were examined during the 13 surveys and oral data was summarised for children aged 5, 6, 9, 12 and 15 years. Fluorosis of deciduous and permanent teeth was recorded using Dean's classification. Fluoride histories were obtained and included the length of residence in Tamworth, water source used for cooking and drinking, and usage of fluoride supplements. The number of children having regular systemic fluoride increased gradually with time from 1963 to 1979. In 1979 and 1988, children who had been lifelong residents of Tamworth comprised 50 percent of the 6-year-olds and 36 percent of the 12-year-olds. Five percent of 6-year-olds and 8 percent of 12-year-olds lived outside of Tamworth and travelled to school. Children without some known systemic fluoride background, other than that obtained at school, accounted for 15 percent of the 12-year-olds. Fluorosis prevalence increased over the years between 1967 and 1988 but the levels were very low and were said to be of no public health concern. In 1967, none of 480 subjects had dental fluorosis. In 1973 it was observed that of 532 subjects, 0.2 percent had questionable and 2.9 percent had very mild fluorosis. In 1979, out of a total of 493 subjects, 1.3 percent had questionable, 5.8 percent had very mild and 0.7 percent had mild fluorosis. And in 1988, out of 259 subjects 1.8 percent had questionable, 1.5 percent had very mild, 0.4 percent had mild and 0.4 percent had moderate fluorosis. Fluorosis prevalence in the 12-year-old group

was three percent in 1973, eight percent in 1979 and four percent in 1988. In 1979, 42 percent of 15-year-olds were reported to have enamel hypoplasia or opacity. Also within this age group, 4 percent had fluorosis in 1979 and 5 percent in 1988. In 1963, 20 percent of children in Tamworth used fluoride supplements. Use of fluoride supplements increased in children living in rural areas and decreased in children living in Tamworth. The use of topical application of fluoride increased quite rapidly from the late 1960's and early 1970's, and by 1979 it became an integral School Dental Service treatment. Topical application of fluoride, as a preventive approach, was also adopted by many dentists in the 1960's and 1970's. Fluoridated toothpaste use was reported to have increased dramatically after Colgate introduced fluoride toothpaste in 1972. By the early 1980's over 90 percent of toothpastes available commercially were fluoridated.

1.6.7 Victoria

Dental fluorosis prevalence in Melbourne 12-year-olds was investigated by Evans *et al.* (1998). The water supplies of Melbourne have been fluoridated since 1977 at an optimum fluoride concentration of 1.0 ppm and it was expected that approximately 10 percent of the subjects, exposed to optimally fluoridated water from birth, examined would have the mildest signs of fluorosis. A total of 644 Melbourne 12-year-old children were examined for signs of dental fluorosis. These children were from randomly selected schools in the Northern and Western metropolitan regions of greater Melbourne. The children's teeth were scored for fluorosis according to Dean's index on the basis of the fluorosis status of the maxillary central incisors. Seventy percent of the sample was classified as having normal enamel, 15 percent as having questionable signs of fluorosis and the remaining 15 percent had signs of very mild or mild fluorosis. Only one individual had signs of moderate fluorosis. Dean's CFI was 0.26. Fluorosis was found to be significantly associated with residence history in a fluoridated area, and 18 percent of lifelong residents had definite signs of fluorosis. It appeared from the results that fluorosis risk had not increased in Melbourne since the introduction of water fluoridation. It was also concluded that the degree of dental fluorosis was within expected limits for an optimally fluoridated community. This degree of fluorosis was considered to be of no public health concern.

1.6.8 Water fluoridation in Australia

Spencer *et al.* (1996) reviewed among other things, the trends in dental fluorosis in Australia. Two phenomena were seen to be creating an interest in dental fluorosis. First, there was reaction among dental practitioners and the media to dental fluorosis in the community. It was reported that children aged 10 to 17 years old were able to distinguish between very mild and mild fluorosis. Second, there was evidence that the prevalence of dental fluorosis had increased. Two separate studies conducted in the 1990s had shown higher than expected fluorosis prevalence. Attention was drawn to the work of Riordan (see elsewhere). It was also reported that, Puzio and Spencer (personal communication) had used both the TF and Dean Indices to study dental fluorosis among children aged 10 to 17 years old in South Australia. The prevalence of dental fluorosis using the TF index was found to be 0.29 among children not exposed to fluoridated water and 0.57 among those exposed to fluoridated water. The prevalence of fluorosis using Dean's index was found to be 0.19 for children not exposed to fluoridated water and 0.35 for those exposed to fluoridated water. It appeared that the prevalence of dental fluorosis among children had increased to levels above those expected as a result of water fluoridation alone. It also seemed that with increased prevalence of dental fluorosis, the risk from exposure to fluoride from other sources had increased. Conclusions were that water fluoridation, infant formula, fluoride supplements, and fluoride toothpastes have become targets for reducing exposure to fluoride. It was reported that the NHMRC and the Consensus Conference on Appropriate Fluoride Exposure for Infants and Children (held in Perth, 2002) have recommended that exposure to discretionary fluorides among infants and children be controlled.

1.7 Prevalence of dental fluorosis internationally

Singapore was the first country in Asia to institute water fluoridation (Loh, 1996). Taking the climatic conditions of Singapore into consideration, the fluoride level in the water was adjusted to 0.7 ppm in 1958. A total of 2,090 children aged 11 to 13 years were examined in 1989 in order to evaluate the extent of developmental defects in dental enamel of children in Singapore. Of these, 50.3 percent children had no fluorosis, 11.6 percent had questionable fluorosis, 26.6 percent had very mild, 10.5 percent had mild fluorosis, 0.9 percent had moderate and 0.1 percent had severe fluorosis. The Community Fluorosis Index was 0.56. The results from this study and the reported downward adjustment of

fluoride levels in water supplies in Hong Kong prompted the Ministry of Health in Singapore to lower the fluoride levels in the water supplies to 0.6 ppm.

Pendrys (2000) conducted a study in the United States to determine the prevalence of fluorosis and the attributed risk percent estimates for enamel fluorosis. The subjects examined were aged 10 to 14 years and were divided into two groups. One of the groups belonged to the non-fluoridated areas in Massachusetts and Connecticut (429 subjects) and the other to the fluoridated areas in Connecticut (234 subjects). The examinations were carried out by two examiners using the Fluorosis Risk Index to measure enamel fluorosis. The history of fluoride exposure was obtained through questionnaires completed by the parents. The prevalence of mild to moderate enamel fluorosis was found to be 0.39 for the non-fluoridated areas and 0.34 for the optimally fluoridated areas. Maxillary anterior teeth were found to be involved in 84 percent of the non-fluoridated sample and 74 percent of the fluoridated sample. A significant association of enamel fluorosis was found with the age of starting toothbrushing and frequency of toothbrushing in the non-fluoridated sample, and with amount of toothpaste used and frequency of toothbrushing in the fluoridated sample. The findings also indicated that early use of fluoride supplements was attributed with nearly two-thirds of the mild to moderate cases of enamel fluorosis in the non-fluoridated areas and with about 13 percent of the cases in the fluoridated areas. It was also found that the use of infant formula accounted for nearly 10 percent of the enamel fluorosis cases in the fluoridated areas. The study concluded that the prevalence of mild to moderate enamel fluorosis in non-fluoridated and optimally fluoridated areas was associated with early toothbrushing habits. Also, that one-third of the mild to moderate cases of enamel fluorosis in non-fluoridated areas and two-thirds of the cases in fluoridated areas could be attributed to early fluoride toothpaste use.

In another study in the United States, Griffin *et al.* (2002) obtained prevalence estimates for enamel fluorosis from the National Survey of Oral Health in U.S. School Children (1986-87) to determine aesthetically objectionable fluorosis attributable to water fluoridation. The recording of the enamel fluorosis in fully erupted permanent teeth was done, in the survey, using Dean's criteria and scoring system. The sample size was restricted to subjects whose residence water supplies were optimally fluoridated, and if the fluoridation status was consistent with the school water sample. The children were aged 12

to 14 years had never been exposed to fluoride tablets or drops. Analysis was carried out for 1839 children who had at least one anterior tooth scored for fluorosis. The children were divided into two groups based on the fluoride content of the school water supplies: low ($F \leq 0.3$ ppm) and optimal ($0.7 \text{ ppm} \leq F \leq 1.2 \text{ ppm}$). Dean's fluorosis index (CFI) representing the second highest fluorosis score for all teeth and anterior fluorosis index (AFI) representing the highest score among maxillary teeth were calculated. The enamel fluorosis prevalence of mild or greater fluorosis score was 0.26 using CFI and 0.18 using AFI. It was thus found that posterior teeth were more likely to be affected than anterior teeth. Using CFI, 33 percent of the children in the optimally fluoridated group and 9 percent in the low fluoridation group were found to have very mild or greater enamel fluorosis.

Whelton *et al.* (2004) conducted a study to determine the prevalence of dental caries and fluorosis in the Republic of Ireland and to report changes in levels between 1984 and 2002. A total of 17,851 children aged 5, 8, 12 and 15 years were selected randomly. Dental fluorosis was recorded using Dean's Index in natural light. The fluorosis results were given for the age groups of 8, 12 and 15-year-olds. In the fluoridated areas, 76 percent of 8-year-olds, 71 percent of 12-year-olds and 61 percent of 15-year-olds were given a score of "normal". In the non-fluoridated areas the score of "normal" was given to 90 percent of the 8-year-olds, 82 percent of the 12-year-olds and 81 percent of the 15-year-olds. The difference of distribution of dental fluorosis in the two regions was found to be statistically significant ($p < 0.0001$). In 1984, dental fluorosis among the 8-year-olds according to Dean's Index was 94 percent "normal", 5 percent "questionable" and 1 percent "mild". For the 15-year-olds it was 95 percent "normal", 4 percent "questionable" and 1 percent "mild". An increase in the prevalence of dental fluorosis was noted for the 8-year-olds and the 15-year-olds between 1984 and 2002 and the difference was found to be statistically significant ($p < 0.0001$ for both groups). It was concluded that prevalence of fluorosis was higher for children having fluoridated water supplies.

1.7.1 The York Review

The National Health Service (UK) Centre of Reviews and Dissemination at the University of York (CRD) carried out a review of studies pertaining to water fluoridation (Treasure *et al.*, 2002). One of the objectives of the review showed that the only negative effect of

water fluoridation was fluorosis, and that fluoridated drinking water was the main factor associated with this risk. The papers included in this assessment fulfilled the criteria of having two different populations exposed to different fluoride concentrations. The method described by Hawley *et al.* (1996) was used to determine the percentage of children fluorosed, where it is noted that, “the prevalence of aesthetically objectionable dental fluorosis was low and that mild fluorosis was associated with a lower risk of dental caries and a more acceptable appearance. It is essential that a balanced view of the relative benefits and risks of the use of fluorides is maintained and proven benefits are not overwhelmed by largely unfounded aesthetic concerns”. It was estimated that at levels of 1.0 ppm F, the prevalence of fluorosis was 0.48, and 0.13 prevalence for fluorosis with aesthetic concern. At levels of 0.1 ppm F, the prevalence of fluorosis was estimated to be 0.15, and 0.06 prevalence for fluorosis with aesthetic concern. The authors concluded that dental fluorosis was associated with fluoridated drinking water supplies.

1.8 Perceptions of dental fluorosis

A study was carried out among registered orthodontists practising in Western Australia to investigate the specialist clinicians’ perceptions of dental fluorosis (Riordan, 1993c). An interview method was used to assess the knowledge of the orthodontists in relation to prevalence of enamel mottling, relation of mottling and fluoride intake, and if enamel mottling was a problem for their patients. A total of 34 registered orthodontists participated in the survey; 32 of them were from Perth (0.8 mg/L F). The mean period since their graduation as a dentist was 22.5 years. A majority of the orthodontists felt that the prevalence of fluorosis was increasing and virtually all of them had noticed defects of the enamel. It was perceived that “patients and/or parents were more concerned about enamel defects than were the orthodontists”. When specifically asked, the orthodontists linked fluoride with the enamel defects, and a majority of them identified fluoride in water as its principal source. It was observed during the study that many of the orthodontists had only a general idea about fluoride sources and also that they would not be able to give preventive advice to the parents of young children. From these observations it was felt that courses were needed to update clinicians about current issues in dentistry, such as fluorosis.

In a later study, Riordan (1993a) gathered the opinion of lay people with regard to appearance of teeth of children with varying degrees of fluorosis. There were 28 children

included in the study. The children were aged 14 years and had teeth with TF scores ranging from 0 to 3. The observers, 110 in number, were gathered into five groups consisting of 28 first year preclinical students, 37 nutrition students, 16 parents, 17 administrative staff, and 12 dentists. The child subjects were asked to sit upright in dental chairs. All chairs were located in the same clinic that was well lit by daylight and artificial lights. Observations were made at a “conversational” distance from each subject and the observers noted their responses onto a questionnaire. The questionnaire was designed to ascertain the feelings of the observers about the appearance of children’s teeth and how they imagined different degrees of fluorosis might impact on the children. The results indicated that low TF scores might not embarrass the children and that higher scores (TF=3) could be a source of embarrassment, particularly for the girls. It was found that the dentists felt more strongly about the higher TF scores and would recommend treatment for children who had TF score 3. It was also observed that higher fluorosis scores were seen by many lay people as neglect on part of the children towards their teeth. The author concluded that in order to prevent the occurrence of fluorosis at TF score 3, fluoride ingestion from other sources such as toothpastes, infant formulas and supplements needed to be controlled.

PART II

**DENTAL FLUOROSIS IN THE BLUE MOUNTAINS
AND HAWKESBURY REGIONS**

2. Introduction

Australia is celebrating 50 years of water fluoridation since its introduction in Beaconsfield, Tasmania in 1953 (Barnard, 1969).

Water fluoridation was introduced in New South Wales in Yass in 1956 (Altree-Williams, 1972). Sydney commenced the fluoridation of its water supplies in 1968 and the fluoride level was adjusted to 1.0 ppm (Anon, 1968).

2.1 Water fluoride levels in Australia

The target fluoride level in the water supplies for Australian cities varies according to climatic conditions, as can be seen in the following list:

- *Tasmania* – Hobart 1.1 ppm
- *New South Wales* – Sydney 1.0 ppm
- *Victoria* – Melbourne 1.0 ppm
- *Australian Capital Territory* – Canberra 1.0 ppm
- *Queensland* – Townsville 1.0 ppm
- *South Australia* – Adelaide 0.9 ppm
- *Western Australia* – Perth 0.8 ppm
- *Northern Territory* – Darwin 0.6 ppm

Optimal concentrations for cooler or warmer climatic regions are set at above and below 1.0 ppm respectively, since fluid intake and hence fluoride dose from drinking water varies according to climatic conditions (Fejerskov *et al.*, 1977). It has been demonstrated that higher than expected levels of fluorosis may occur in association with near optimal concentrations of fluoride in drinking water, but this may be corrected by adjusting the fluoride concentration downwards (Evans and Stamm, 1991b).

2.2 Risk of fluorosis

Dean had arbitrarily defined the minimal threshold of fluoride concentration in a domestic supply as “the highest concentration of fluoride incapable of producing a definite degree of mottled enamel in as much as 10 percent of the group examined” (Dean, 1935). However, it has been recently reported that the prevalence of dental fluorosis is increasing in areas

with water fluoridation and also in non-fluoridated areas, 0.40 and 0.33 respectively (Riordan, 1991).

A WHO report states that some degree of dental fluorosis would always occur in trying to achieve effective fluoride based caries prevention; therefore efforts need to be made in minimizing dental fluorosis while maximising caries prevention (The World Oral Health Report, 2003. pp19). The York Review (a systematic review of public water fluoridation) summarised results confirming the association of dental fluorosis with fluoridated water (Treasure *et al.*, 2002).

2.3 Water fluoridation in the Blue Mountains

The New South Wales Water Board assumed control of the water supply in the Blue Mountains in 1980, and this move brought about the fluoridation of the water supplies in this region (Patterson and Weidenhofer, 1993). The fluoridation of the water supplies to the Blue Mountains was completed in 1992 and the fluoride concentration was adjusted to 1.0 ppm.

2.4 Baseline survey

In 1992 Patterson and Weidenhofer carried out a survey in the Blue Mountains and Hawkesbury Local Government Areas (LGA) of Sydney. The study sought to establish whether there was any significant difference in the prevalence of dental caries in the deciduous dentition of primary school children with continuous residence in the two survey areas, and to establish baseline data against which future data would be compared.

The water supplies of the Hawkesbury LGA have been fluoridated since 1969. It was chosen as the comparison site due to its similar socio-demographic profile and geographic proximity to the Blue Mountains. The baseline survey dealt only with dental caries experience in the primary dentition; fluorosis status was not assessed.

2.5 Demographic Description of Blue Mountains and Hawkesbury

The Blue Mountains LGA has a population of approximately 74,317 (07th August 2001) of which 16,116 were in the 0 – 14 years age group. This region extends from Lapstone in the

east to Mt Victoria in the west, north to Bell and follows the Bells Line of Road to Berambing (www.bmcc.nsw.gov.au).

The Hawkesbury LGA has a population of approximately 63,548 (30th June, 2001) of which 12,273 were in the 0 – 11 years age group. This region extends from the Cumberland Plain in the south and the east, to the foothills and escapements of the Blue Mountains to the west and the north (www.hawkesbury.nsw.gov.au).

(Map of the Blue Mountains and Hawkesbury – Appendix A)

2.6 Purpose of the study

This study is part of a larger study to evaluate the extension of water fluoridation to the Blue Mountains LGA for the prevention of dental caries.

The purposes of this study were:

1. To determine whether the adjustment of the fluoride concentration to 1 ppm in the drinking water supplied to the Blue Mountains was associated with anticipated low fluorosis prevalence.
2. To determine the similarity or otherwise in fluorosis severity in the Blue Mountains and Hawkesbury regions.
3. To evaluate the risk of fluorosis from fluoride sources other than fluoridated water.

2.7 Ethics review

Permission for the survey was obtained from the Human Research Ethics Committees of the following organisations:

- The University of Sydney
- New South Wales Department of Education and Training
- Wentworth Area Health Services

(Ethics approval – Appendix B)

3. Material and Methods

3.1 Target Sample

The target sample was the primary school children in the Blue Mountains and Hawkesbury Local Government Areas of Sydney, New South Wales.

3.2 Sampling

The 1992 baseline survey conducted by Patterson and Weidenhofer (1993) was carried out in 18 schools. These were “selected randomly using comparative size as the main criteria. Additionally some smaller schools were included and attempts were made to obtain a reasonable geographic spread across the LGA”. The selected schools are listed below:

Blue Mountains LGA

Blackheath Gateway Christian
Blackheath Public
Katoomba North Public
Katoomba Public
Leura Public
Mt Victoria Public
St Canice’s Primary School

Hawkesbury LGA

Bilpin Public
Cattai Public
Ebenezer Public
Glossodia Public
Kurrajong North Public
Kurrajong Public
Kuyper Christian
Maraylaya Public
Oakville Public
Vineyard
Wilberforce Public School

The schools, as selected for the 1993 survey, became the target schools for the 2003 survey. However, two schools: Kuyper Christian (107 pupils) and Vineyard (16 pupils) in the Hawkesbury LGA were excluded as they had come under the purview of another Area Health Service.

3.3 Recruitment of sample

The principals of the selected schools were sent letters of invitation to include their schools in the survey. Then each principal was visited, and the purpose of the study was explained to him/her more fully. All of the school principals contacted agreed to include their school in the survey, and completed a formal letter giving consent. They were also asked to provide class lists of children attending their schools. School staff distributed information packages to the parents/guardians of the children and also collected the questionnaires and consent forms that were returned in sealed envelopes.

The information packages forwarded to parents/guardians included an information statement, a request for consent to participate in survey, a consent form, and a questionnaire. The information statement explained the purpose of the study and assured the parents that information supplied by them would be kept confidential. Parents were requested to return the completed questionnaire and the consent form to the school before the date set for examining the children at the particular school. A reminder notice was sent to the parents a week after forwarding the information packages through their children. Only children whose parents/guardians gave consent for inclusion in the survey were examined.

(Information package for school principals & parents – Appendix C & D)

3.4 Fluoride history

The questionnaire used for the survey was obtained from the Australian Research Centre for Population Oral Health (ARCPOH). This questionnaire had been used previously in Australia, and was used in this survey to allow for standardised data collection. The questionnaire was used as such, except for amendments made to a couple of questions so as to suit local conditions.

The questionnaire sought demographic information as well as a detailed fluoride history regarding exposure to fluoridated water and use of toothpastes, fluoride supplements, fluoride mouthrinses, and application of fluoride gels.

(The questionnaire – Appendix E)

3.5 Measurement of fluorosis

Dean's index criteria were followed for recording dental fluorosis, as recommended by the World Health Organisation (WHO, 1997). The codes and criteria of Dean's index are as follows:

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

The WHO reference photographs were used as the diagnostic standards. The author was calibrated against his supervisor in the application of the diagnostic criteria where the WHO reference photographs were used as the diagnostic standard. Russell's differential diagnosis criteria for fluorosis were followed (*Appendix I*).

3.6 Clinical Examination

All children were examined on the campus of the schools visited. In this study, dental fluorosis was assessed in relation to the maxillary central incisors alone. The permanent maxillary central incisors of the children were selected for the following reasons:

- Ease of accessibility
- The aesthetic aspect of fluorosis is mainly relevant to maxillary anterior teeth

The examination was carried out by a single examiner who had been calibrated before the survey. Intra-examiner calibration was periodically carried out during the survey, and inter-examiner calibration was also carried out at regular intervals with the calibrating examiner.

Examinations were carried out in shaded natural daylight, either indoors beside a window or outdoors under an awning. The examiner recorded the fluorosis rank for each subject on a class list obtained from the school. In addition, the maxillary anterior teeth were photographed indoors using a digital camera (Canon EOS 10D) with an attached macro ring flashlight. The use of the digital camera enabled a check of the photograph quality before proceeding to the next subject and the macro ring light provided a uniform light source. Photographs were retaken as necessary. The fluorosis rank was later entered into an electronic database for subsequent statistical analysis, the photograph number being linked to the subject ID number.

(See CD for photographic examples of Dean Index ranks – Appendix J)

3.7 Analysis

Following data entry of the completed questionnaires into an electronic database, distributions of variable values were checked for internal inconsistencies. When discrepancies were noted, the questionnaires were checked and the database was amended accordingly.

The analysis of the data was carried out using the SAS statistical software for windows (Version 8, copyright by SAS Institute Inc., Cary, NC, USA). It should be noted that Dean fluorosis ranks or scores are ordinal measurements and that they are, nevertheless, treated as continuous measurements in some situations, such as in the calculation of the Community Fluorosis Index, CFI.

3.7.1 Reliability of measurements: The analysis of the 194 duplicate measurements (both intra- and inter-examiner) was assessed via calculations of the Kappa statistic (Evans *et al.*, 1987). Values, using SAS software, are expressed in terms of simple kappa and weighted kappa.

3.7.2 Bivariate analyses: Bivariate analyses of Dean fluorosis rank with all potential independent/explanatory variables were carried out. Chi-square analysis was used to evaluate statistical associations with categorical variables, and regression methods were used to evaluate fluorosis associations with continuous variables. In cases where the chi-square analysis was problematic because of low frequencies in some cells of the table,

categories were collapsed to remove this problem and the analysis was redone using either the Chi-square or Fisher's Exact Test.

3.7.3 The assessment of potential explanatory variables: The assessment of potential explanatory variables was evaluated by logistic regression methods. In these analyses, the Dean ranks were dichotomised as FLU1 where 0 = (normal) and 1 = (questionable + very mild + mild + moderate + severe). The outcome of univariate analyses was that only a few predictors for FLU1 were associated with significant odds ratios (OR). In order to improve the possibility of obtaining better explanatory models, the ranks were then dichotomised as FLU2 and FLU3 where for FLU2, 0 = (normal + questionable) and 1 = (very mild + mild + moderate + severe) and for FLU3, 0 = (normal + questionable + very mild) and 1 = (mild + moderate + severe).

Univariate logistic regression analyses were carried out in relation to all predictors of FLU2. Predictor variables for FLU2 that were associated with significant ORs (at the $p < 0.2$ level) were then entered into a multivariable logistic regression. The best fitting multiple regression model was identified using backward stepwise regression selection. This process was followed also in relation to FLU3.

4. Results

4.1 The sample

A total of 3,100 children enrolled in the sixteen schools were targeted to be included in the survey. Of these, 1,963 children who had parental consent participated (Table 1). The response rate was 63 percent (from 53 percent in one school to 88 percent in another).

Table 1: Total children examined

Age (in years)	Blue Mountains			Hawkesbury			Total
	Male	Female	Both	Male	Female	Both	
5	21	23	44	14	17	31	75
6	67	93	160	81	82	163	323
7	60	72	132	68	73	141	273
8	63	72	135	86	76	162	297
9	74	57	131	78	82	160	291
10	57	69	126	81	66	147	273
11	55	39	94	64	77	141	235
12	39	38	77	51	61	112	189
13	3	1	4	2	1	3	7
Total	439	464	903	525	535	1060	1963

A total of 1,352 children with erupted (at least half) permanent maxillary central incisors were examined for fluorosis at their schools (Table 2).

Table 2: Distribution of children with erupted maxillary central incisors

Age (in years)	Blue Mountains			Hawkesbury			Total
	Male	Female	Both	Male	Female	Both	
5	1	0	1	1	1	2	3
6	1	6	7	1	6	7	14
7	17	28	45	27	34	61	106
8	48	60	108	82	69	151	259
9	63	52	115	77	83	160	275
10	56	72	128	75	62	137	265
11	51	40	91	66	76	142	233
12	38	39	77	51	60	111	188
13	5	1	6	2	1	3	9
Total	280	298	578	382	392	774	1352

The distribution of Dean Index ranks is shown in Table 3. The prevalence of fluorosis (very mild or more) in the surveyed regions was 0.39 and the overall CFI value in the two regions was 0.66.

Table 3: Community Fluorosis index (CFI) by region

Fluorosis Rank	Blue Mountains		Hawkesbury		Overall	
	Number	Percent	Number	Percent	Number	Percent
Normal	113	19.6	247	31.9	360	26.6
Questionable	239	41.3	224	28.9	463	34.2
Very mild	181	31.3	245	31.7	426	31.5
Mild	33	5.7	50	6.5	83	6.1
Moderate	8	1.4	5	0.6	13	1.1
Severe	4	0.7	3	0.4	7	0.5
Total	578	100	774	100	1352	100
Fluorosis Prevalence	0.39		0.39		0.39	
CFI	0.70		0.63		0.66	

School region: The CFI of the two school regions, Blue Mountains (CFI = 0.7) and Hawkesbury (CFI = 0.63), differed significantly ($p < 0.0001$). The difference is accounted for entirely by variations in the distribution of normal and questionable ranks only in the two regions; the rank distributions for very mild, mild, moderate, and severe were almost identical in both regions.

4.2 Risk factors for fluorosis

The bivariate analysis of the Dean fluorosis ranks by potential explanatory variables showed that in addition to SCHOOL REGIONS (Blue Mountains and Hawkesbury), only six out of 59 potential explanatory variables were significantly associated with fluorosis (Table 4). These were TBEVER (If child had ever brushed his/her teeth with toothpaste); TBSPIT2 (What the child did after brushing now) (Note that TBSPIT1 - When child first started brushing, did s/he just swallow, rinse and swallow, etc was not significantly associated with the Dean Index); FRIN (If child had ever used fluoride mouthrinse); FORMIX (Infant formula reconstituting agent); ABTS (If child was of Aboriginal or Torres Strait Islander origin); and JOBF (Mother’s occupation).

(Bivariate analyses tables – Appendix G)

4.2.1 Fluorosis risk from exposure to fluoridated water: There was no meaningful pattern in fluorosis severity in relation to number of year's exposure to fluoridated water (Table 4).

4.2.2 Fluorosis risk from exposure to fluoride containing toothpaste

4.2.2.1 Toothbrushing history: Nearly 70 percent of children were reported to have commenced toothbrushing, either by themselves or assisted by parents, by age 2 years. The age of the child at the commencement of toothbrushing was not significantly associated with the Dean Index ranks (Table 4)

4.2.2.2 Toothbrushing frequency: The subjects, who presented with mild, moderate, or severe fluorosis, were distributed in the same proportions across the different brushing frequency categories (Table 4).

4.2.2.3 Toothpaste type: The variation in fluorosis distribution was not significantly associated with the type of toothpaste used. Of 1305 subjects, 301 used standard fluoride toothpaste, 976 used a children's toothpaste, 17 used non-fluoridated toothpaste and parents of 11 subjects were not sure of the type of toothpaste used (Appendix G – Table F9). The 20 subjects, who presented with moderate or severe fluorosis, used either standard fluoridated toothpaste or children's toothpaste. The 17 children who used non-fluoride toothpaste had only questionable or very mild fluorosis.

4.2.2.4 Tendency to ingest toothpaste: Parents reported that, 102 children often licked toothpaste when toothbrushing first commenced, 507 children sometimes licked toothpaste and 695 children never licked toothpaste (Table 4). However, the proportional distribution of fluorosis ranks was similar across all licking frequency categories.

4.2.2.5 Toothbrush size and amount of toothpaste dispensed: Of 1302 subjects, 1215 brushed their teeth with a small size toothbrush and 87 brushed with a regular size toothbrush (Appendix G – Table F13). Of the 20 subjects who presented with moderate or severe fluorosis, 18 used a small sized brush and only two used a regular sized brush. The reported amount of toothpaste dispensed was also not significantly associated with variation in CFI, which were similar across all categories (Table 4).

Table 4: Distribution of Dean fluorosis rank (FLU) and related statistics by potential explanatory variables

Outcome variable		Number	CFI
FLU (Dean fluorosis rank)	0 - Normal	360	
	1 - Questionable	463	
	2 - Very mild	426	
	3 - Mild	83	
	4 - Moderate	13	
	5 - Severe	7	
Total		1352	0.66

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
AGE (Continuous)	5 years to 13 years	1352	0.66	Regression of FLU on AGE	-0.0013		1351	0.01	0.9
SEX	1. Male	662	0.64	Across all categories					0.4*
	2. Female	690	0.68						
SCHOOL School region	1. Blue Mountains	578	0.70	Across all categories					<0.001*
	2. Hawkesbury	774	0.63						
TBEVER Ever brushed child's teeth with toothpaste	1. Yes	1335	0.65	Across categories (0) and (1)					0.03*
	2. No	2	0.25						
	0. Missing/excluded data	15	1.07						
TBAGE (Continuous) Age when started brushing with toothpaste	Unit - years	1256	0.66	Regression of FLU on TBAGE	-0.030		1255	2.06	0.2
	Missing/excluded data	96	0.64						

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
TPTIMES1 Frequency of brushing with toothpaste when toothbrushing commenced	1. Less than once a day	154	0.54	Across categories (1) (2) (3) (4)		11.8	9		0.2
	2. Once a day	620	0.67	Dean (0) (1) (2) (3,4,5)					
	3. Twice a day	516	0.67						
	4. More than twice	16	0.53						
	0. Missing/excluded data	46	0.78						
TPTIMES2 Frequency of brushing with toothpaste now	1. Less than once a day	76	0.65	Across categories (1) (2) (3,4)		4.5	6		0.6
	2. Once a day	434	0.63	Dean (0) (1) (2) (3,4,5)					
	3. Twice a day	783	0.67						
	4. More than twice	12	0.46						
	0. Missing/excluded data	47	0.73						
TPTYPE1 Type of toothpaste used when toothbrushing commenced	1. Fluoride toothpaste	301	0.65	Across categories (1) (2) (3,4)		1.8	6		0.9
	2. Children's toothpaste	976	0.66	Dean (0) (1) (2) (3,4,5)					
	3. Non-fluoridated paste	17	0.59						
	4. Don't know/not sure	11	0.77						
	0. Missing/excluded data	47	0.76						
TPTYPE2 Type of toothpaste used now	1. Fluoride toothpaste	983	0.65	Across categories (1) (2) (3,4)		5.5	6		0.5
	2. Children's toothpaste	289	0.68	Dean (0) (1) (2) (3,4,5)					
	3. Non-fluoridated paste	20	0.53						
	4. Don't know/not sure	5	0.60						
	0. Missing/excluded data	55	0.73						
TPLICK1 Child eating or licking toothpaste when toothbrushing commenced	1. Often	102	0.79	Across categories (1) (2) (3)		10.0	6		0.1
	2. Sometimes	507	0.65	Dean (0) (1) (2) (3,4,5)					
	3. Never	695	0.63						
	0. Missing/excluded data	48	0.79						
TPLICK2 Child eating or licking toothpaste now	1. Often	13	0.65	Across categories (1,2) and (3)		1.8	3		0.6
	2. Sometimes	223	0.71	Dean (0) (1) (2) (3,4,5)					
	3. Never	1066	0.64						
	0. Missing/excluded data	50	0.74						

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
TBSIZE1 Size of toothbrush when toothbrushing commenced	1. Small size 2. Regular size 0. Missing/excluded data	1215 87 50	0.66 0.66 0.73	Across categories (1) and (2)					0.6*
TBSIZE2 Size of toothbrush now	1. Small size 2. Regular size 0. Missing/excluded data	558 742 52	0.63 0.68 0.69	Across categories (1) and (2)					0.4*
TBSPIT1 What child did after toothbrushing when toothbrushing commenced	1. Just swallow 2. Rinse and swallow 3. Rinse and spit 4. Just spit 5. Other 6. Don't know 0. Missing/excluded data	172 140 769 179 4 41 47	0.69 0.70 0.65 0.61 0.38 0.65 0.77	Across categories (1) (2) (3) (4,5,6) Dean (0) (1) (2) (3,4,5)		7.0	9		0.6
TBSPIT2 What child does after toothbrushing now	1. Just swallow 2. Rinse and swallow 3. Rinse and spit 4. Just spit 5. Other 6. Don't know 0. Missing/excluded data	19 46 1129 102 1 4 51	1.03 0.84 0.65 0.62 0.00 0.50 0.75	Across categories (1,2) and (3,4,5,6) Dean (0) (1) (2) (3,4,5)		11.6	3		0.009
TPP1 Amount of toothpaste used on child's toothbrush when toothbrushing commenced	1. Large amount 2. Pea sized 3. Small amount 0. Missing/excluded data	111 426 765 50	0.74 0.65 0.64 0.73	Across categories (1) (2) (3) Dean (0) (1) (2) (3,4,5)		2.3	6		0.9
TPP2 Amount of toothpaste used on child's toothbrush now	1. Large amount 2. Pea sized 3. Small amount 0. Missing/excluded data	434 679 186 53	0.65 0.68 0.60 0.71	Across categories (1) (2) (3) Dean (0) (1) (2) (3,4,5)		8.1	6		0.2

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
FTAB Ever taken fluoride tablets or drops	1. Fluoride tablets only 2. Fluoride drops only 3. Fluoride tablets and drops 4. No fluoride tablets or drops 5. Don't know 0. Missing/excluded data	56 37 11 1225 3 20	0.68 0.57 0.68 0.66 0.33 0.93	Across categories (1,2,3) and (4)					0.5*
T1AGE (Continuous) Age started fluoride tablets or drops	Unit - years Missing/excluded data	84 1268	0.68 0.66	Regression of FLU on T1AGE	0.017		83	0.16	0.7
T2AGE (Continuous) Age stopped fluoride tablets or drops	Unit - years Missing/excluded data	67 1285	0.58 0.66	Regression of FLU on T2AGE	-0.075		66	2.65	0.1
TAB1 (Continuous) Fluoride tablets taken (Birth - 6 months)	Unit - number of tablets Missing/excluded data	2 1350	0.50 0.66	No comparisons were attempted					
DROP1 (Continuous) Fluoride drops taken (Birth - 6 months)	Unit - number of drops Missing/excluded data	12 1340	0.58 0.66	Across frequencies					0.8*
TAB2 (Continuous) Fluoride tablets taken (6 months - 4 years)	Unit - number of tablets Missing/excluded data	30 1322	0.75 0.66	Across frequencies					0.8*
DROP2 (Continuous) Fluoride drops taken (6 months - 4 years)	Unit - number of drops Missing/excluded data	21 1331	0.67 0.66	Across frequencies					0.7*
TAB3 (Continuous) Fluoride tablets taken (after age 4)	Unit - number of tablets Missing/excluded data	41 1311	0.71 0.66	Across frequencies					0.5*

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
DROP3 (Continuous) Fluoride drops taken (after age 4)	Unit - number of drops Missing/excluded data	18 1334	0.64 0.66	Across frequencies					0.1*
TOF1 Frequency of fluoride tablets or drops intake (Birth - 6 months)	1. More than once a day 2. Once a day 3. 5 to 6 times a week 4. 2 to 4 times a week 5. Once a week 6. Infrequently/varied 7. Did not take at this age 0. Missing/excluded data	1 13 0 3 0 1 35 1299	0.50 0.54 0.00 0.83 0.00 0.50 0.69 0.66	Across categories (1,2) (3,4) (5,6) Dean (0) (1) (2)					0.5*
TOF2 Frequency of fluoride tablets or drops intake (6 months - 4 years)	1. More than once a day 2. Once a day 3. 5 to 6 times a week 4. 2 to 4 times a week 5. Once a week 6. Infrequently/varied 7. Did not take at this age 0. Missing/excluded data	3 38 1 7 2 5 18 1278	0.67 0.64 0.50 0.57 1.00 0.40 0.75 0.66	Across categories (1,2) (3,4) (5,6) Dean (0) (1) (2) (3)					0.7*
TOF3 Frequency of fluoride tablets or drops intake (after age 4)	1. More than once a day 2. Once a day 3. 5 to 6 times a week 4. 2 to 4 times a week 5. Once a week 6. Infrequently/varied 7. Did not take at this age 0. Missing/excluded data	2 40 2 3 5 14 17 1269	0.75 0.65 0.25 0.67 0.60 0.75 0.65 0.66	Across categories (1,2) (3,4) (5,6) Dean (0) (1) (2) (3)					0.6*
FRIN Ever used fluoride mouthrinse	1. Yes 2. No 3. Don't know 0. Missing/excluded data	109 1188 35 20	0.78 0.64 0.71 0.90	Across categories (1) (2) (3) Dean (0) (1) (2) (3,4,5)		15.0	6		0.02

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
RAGE1 (Continuous)	Unit - years	95	0.78	Regression of FLU on RAGE1	-0.0063		94	0.02	0.9
Age started using fluoride mouthrinse	Missing/excluded data	1257	0.65						
RAGE2 (Continuous)	Unit - years	19	0.71	Regression of FLU on RAGE2	0.031		18	0.11	0.7
Age stopped using fluoride mouthrinse	Missing/excluded data	1333	0.66						
ROF1	1. Every day	12	0.75	Across categories (1) (2) (3) (4)					0.6*
Frequency of fluoride mouthrinse use when started using fluoride mouthrinse	2. A few times a week	19	0.87	Dean (0) (1) (2) (3)					
	3. Once a week	17	0.74						
	4. Infrequently	52	0.77						
	0. Missing/excluded data	1252	0.65						
ROF2	1. Every day	10	0.45	Across categories (1) (2) (3) (4)					0.2*
Frequency of fluoride mouthrinse use now or when stopped using fluoride mouthrinse	2. A few times a week	18	0.75	Dean (0) (1) (2) (3)					
	3. Once a week	17	0.76						
	4. Infrequently	52	0.82						
	0. Missing/excluded data	1255	0.65						
FGEL1	1. Yes	67	0.62	Across categories (1) (2) (3)			2.9	6	0.8
Fluoride gel application by School Dental Service	2. No	736	0.65	Dean (0) (1) (2) (3,4,5)					
	3. Don't know	270	0.65						
	0. Missing/excluded data	279	0.69						
FGEL1X (Continuous)	Unit - application frequency	56	0.64	Regression of FLU on FGEL1X	0.018		55	0.01	0.9
Frequency of fluoride gel application by School Dental Service	Missing/excluded data	1296	0.66						
FGEL2	1. Yes	324	0.65	Across categories (1) (2) (3)			8.5	6	0.2
Fluoride gel application in private dental practice	2. No	773	0.67	Dean (0) (1) (2) (3,4,5)					
	3. Don't know	127	0.63						
	0. Missing/excluded data	128	0.68						

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
FGEL2X (Continuous)	Unit - application frequency	309	0.65	Regression of FLU on FGEL2X	-0.0048		308	0.03	0.9
Frequency of fluoride gel application in private dental practice	Missing/excluded data	1043	0.66						
FGEL3	1. Yes	8	0.56	Across categories (1,3) and (2)		1.4	3		0.7
Fluoride gel application at home	2. No	978	0.65	Dean (0) (1) (2) (3,4,5)					
	3. Don't know	27	0.80						
	0. Missing/excluded data	339	0.67						
FGEL3X (Continuous)	Unit - application frequency	9	0.56	Regression of FLU on FGEL3X	-0.15		8	2.42	0.2
Frequency of fluoride gel application at home	Missing/excluded data	1343	0.66						
WF (Continuous)	Unit - years	1319	0.65	Regression of FLU on WF	0.010		1318	0.76	0.4
Time spent in a water fluoridated area	Missing/excluded data	33	0.83						
EXPOSURE	0. Lifelong exposure	953	0.66	Across categories (0) and (1,2,3,4,5)					0.07*
Varying exposure to fluoridated water (from 1 to 5 years, during the first 6 years of life)	1. Exposure from age 1 year	152	0.70						
	2. Exposure from age 2 years	54	0.64						
	3. Exposure from age 3 years	35	0.47						
	4. Exposure from age 4 years	34	0.72						
	5. Exposure from age 5 years	32	0.58						
	Missing/excluded data	92	0.67						
FORM	1. Yes	901	0.67	Across categories (1) and (2,3)					0.4*
Child fed infant formula	2. No	397	0.63						
	3. Don't know	9	0.61						
	0. Missing/excluded data	45	0.70						
FORMIX	1. Tap water - mains supply	689	0.70	Across categories (1) (2,3,4) (5,6)		21.3	6		0.002
Infant formula reconstituting agent	2. Carbon/charcoal filtered water	28	0.77	Dean (0) (1) (2) (3,4,5)					
	3. Osmosis/distillation filtered water	14	0.82						
	4. Mineral/spring water	22	0.70						
	5. Tank water	133	0.53						
	6. Unknown	6	0.42						
	0. Missing/excluded data	460	0.63						

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
PREM Child born prematurely	1. Yes	120	0.72	Across categories (1) and (2,3)					0.4*
	2. No	1115	0.67						
	3. Don't know	4	0.75						
	0. Missing/excluded data	113	0.53						
BWK (Continuous) Birth weight	Unit - kilograms	1193	0.68	Regression of FLU on BWK	-0.030		1192	0.51	0.5
	Missing/excluded data	159	0.52						
KBORN Country where child born	1. Australia	1297	0.66	Across categories (1) and (2)					0.6*
	2. Overseas	31	0.48						
	0. Missing/excluded data	24	0.79						
MBORN Country where mother born	1. Australia	1115	0.65	Across categories (1) and (2)					0.5*
	2. Overseas	210	0.68						
	0. Missing/excluded data	27	0.78						
ENG English mainly spoken at home	1. Yes	1311	0.66	Across categories (1) and (2)					0.7*
	2. No	15	0.50						
	0. Missing/excluded data	26	0.79						
ABTS Child of Aboriginal or Torres Strait Islander origin	1. No	1289	0.65	Across categories (1) and (2,3,4)					<0.05*
	2. Yes, Aboriginal	31	0.79						
	3. Yes, Torres Strait Islander	1	0.50						
	4. Yes, Both	2	0.50						
	0. Missing/excluded data	29	0.76						
SINGLE Child in a one-parent household	1. Yes	260	0.68	Across categories (1) and (2)					0.5*
	2. No	1064	0.65						
	0. Missing/excluded data	28	0.73						
ABTSM Father/male guardian Aboriginal or Torres Strait Islander	1. No	1061	0.66	Across categories (1) and (2,3,4)					0.4*
	2. Yes, Aboriginal	7	0.64						
	3. Yes, Torres Strait Islander	1	0.50						
	4. Yes, Both	0	0.00						
	0. Missing/excluded data	283	0.67						

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
ABTSF Mother/female guardian Aboriginal or Torres Strait Islander	1. No	1257	0.65	Across categories (1) and (2,3,4)					0.4*
	2. Yes, Aboriginal	25	0.66						
	3. Yes, Torres Strait Islander	1	1.00						
	4. Yes, Both	2	0.50						
	0. Missing/excluded data	67	0.78						
EDM Father/fmale guardian's education	1. Some high school	196	0.71	Across categories (1,2) (3,4) (5,6)					0.5
	2. Completed high school	234	0.63	Dean (0) (1) (2) (3) (4,5)					
	3. Some vocational training	144	0.63						
	4. Completed vocational training	230	0.65						
	5. Some University or College	66	0.67						
	6. Completed University or College	191	0.66						
	0. Missing/excluded data	291	0.67						
EDF Mother/female guardian's education	1. Some high school	206	0.72	Across categories (1,2) (3,4) (5,6)					0.08
	2. Completed high school	416	0.66	Dean (0) (1) (2) (3) (4,5)					
	3. Some vocational training	95	0.71						
	4. Completed vocational training	150	0.64						
	5. Some University or College	134	0.55						
	6. Completed University or College	282	0.63						
	0. Missing/excluded data	69	0.78						
						14.1	8		
JOBM Father/fmale guardian's job	1. Managers and administrators	90	0.68	Across categories (1,2,3) (4,5,6) (7,8,9)					0.7
	2. Professionals	108	0.59	Dean (0) (1) (2) (3) (4,5)					
	3. Associate professionals	137	0.60						
	4. Tradespersons	326	0.67						
	5. Advanced clerical and service	39	0.73						
	6. Intermediate clerical and service	48	0.73						
	7. Intermediate production/transport	62	0.78						
	8. Elementary clerical and service	22	0.91						
	9. Labourers	194	0.60						
	0. Missing/excluded data	326	0.67						
						5.1	8		

Potential explanatory variables	Category (numbered)	Number	CFI	Dean Rank Comparisons	Regression coefficient	Chi-square	DF	F value	Probability (Those marked with an asterisk are exact)
JOB Mother/female guardian's job	1. Managers and administrators	44	0.69	Across categories (1,2,3) (4,5,6) (7,8,9)		18.0	8		0.02
	2. Professionals	41	0.56	Dean (0) (1) (2) (3) (4,5)					
	3. Associate professionals	346	0.63						
	4. Tradespersons	84	0.75						
	5. Advanced clerical and service	195	0.63						
	6. Intermediate clerical and service	128	0.63						
	7. Intermediate production/transport	7	0.57						
	8. Elementary clerical and service	22	0.82						
	9. Labourers	48	0.80						
	0. Missing/excluded data	437	0.67						
INC Total household income per year (before tax)	1. Up to \$20,000	146	0.70	Across categories (1,2) (3,4) (5,6)		3.5	6		0.7
	2. \$20,001 to \$40,000	292	0.64	Dean (0) (1) (2) (3,4,5)					
	3. \$40,001 to \$60,000	287	0.70						
	4. \$60,001 to \$80,000	285	0.67						
	5. \$80,001 to \$100,000	119	0.61						
	6. Over \$100,000	87	0.59						
	0. Missing/excluded data	136	0.63						

4.2.2.6 Rinsing after toothbrushing: When toothbrushing first began, 172 just swallowed after brushing, 140 rinsed and swallowed, 769 rinsed and spat, 179 just spat and parents of 45 children are not aware of what their children did after brushing (Appendix G – Table F15). Of the 20 subjects who presented with moderate or severe fluorosis, four just swallowed, three rinsed and swallowed, nine rinsed and spat and one subject just spat. These habits when toothbrushing first began were not associated significantly with CFI. However, rinsing and swallowing habits at the time of examination were significantly associated with CFI values (Table 5). Children that swallowed and did not spit out, or who rinsed and swallowed and did not spit out, were associated with CFI values in the range that is considered to pose a public health problem.

4.2.3 Fluorosis risk from exposure to fluoride supplements: Of 1332 subjects, 56 had consumed fluoride tablets, 37 had consumed fluoride drops, and 11 subjects were exposed to both fluoride tablets and fluoride drops (Appendix G – Table F19). All of the 20 subjects who presented with signs of moderate or severe fluorosis claimed not to have been exposed to any fluoride supplement. Fifty-one children were reported to have been given fluoride drops at various stages during their lives, but none of them had signs of moderate or severe fluorosis (Appendix G – Tables F23, F25, and F27).

4.2.4 Fluorosis risk from exposure to fluoride gel and rinse: Exposure to fluoride gel was not shown to be a fluorosis risk in this sample of children. However, there was a significant association between use of fluoride rinse and fluorosis severity, but those categorised as having the more severe fluorosis signs did not include any of the rinsing subjects (Table 6).

4.2.5 Fluorosis risk from exposure to use of infant formula: Parents of 892 children reported the use of infant formula. The lowest CFI (0.53) value was associated with children whose formula was reconstituted with tank water, and the highest value (0.82) was associated with the use of osmosis/distillation filtered water (Table 7). For most children, the reconstituting water was from the mains supply (apart from tank and mineral/spring water, reconstitution with mains supply was assumed); the associated CFI value was 0.7. These differences were highly significant. Of six of the children whose data were excluded in this analysis, because it was reported that they did not have milk formula, three were classified as having severe fluorosis and three as having moderate fluorosis.

Table 5: Distribution of Dean Index ranks by potential explanatory variable TBSPIT2 (What child does after toothbrushing now)

Dean Index	Just swallow (1)		Rinse and swallow (2)		Rinse and spit (3)		Just spit (4)		Other (5)		Don't know (6)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	1	5.3	7	15.2	305	27.0	34	33.3	1	100.0	2	50.0
Questionable	5	26.3	15	32.6	394	34.9	30	29.4	0	0.0	0	0.0
Very mild	11	57.9	20	43.5	349	30.9	29	28.4	0	0.0	2	50.0
Mild	1	5.3	2	4.4	65	5.8	8	7.8	0	0.0	0	0.0
Moderate	0	0.0	1	2.2	11	1.0	1	1.0	0	0.0	0	0.0
Severe	1	5.3	1	2.2	5	0.4	0	0.0	0	0.0	0	0.0
Total	19	100	46	100	1129	100	102	100	1	100	4	100
CFI	1.03		0.84		0.65		0.62		0.00		0.50	

Missing/excluded data - 51

Chi-square analysis. Categories collapsed as follows:

Categories (1, 2) and (3, 4, 5, 6); Dean (0) (1) (2) (3, 4, 5)

Chi-square = 11.6, $p = 0.009$

**Table 6: Distribution of Dean Index ranks by potential explanatory variable FRIN
(Use of fluoride mouthrinse)**

Dean Index	Yes (1)		No (2)		Don't know (3)	
	Number	Percent	Number	Percent	Number	Percent
Normal	25	22.9	321	27.0	12	34.3
Questionable	31	28.4	414	34.9	10	28.6
Very mild	37	33.9	375	31.6	8	22.9
Mild	16	14.7	59	5.0	4	11.4
Moderate	0	0.0	13	1.0	0	0.0
Severe	0	0.0	6	0.5	1	2.9
Total	109	100	1188	100	35	100
CFI	0.78		0.64		0.71	

Missing/excluded data - 20
 Chi-square analysis. Categories collapsed as follows:
 Categories (1) (2) (3); Dean (0) (1) (2) (3, 4, 5)
 Chi-square = 15.0, *p* = 0.02

4.2.6 Aboriginal and Torres Strait background: Aboriginal children had a significantly higher CFI (0.79) than other children (0.65) (Table 8). However, this variation was not evident in consideration of whether or not their parents were Aboriginal.

4.2.7 Occupation of Mother: The distribution of mothers' occupational rank, categorised according to the Australian Bureau of Statistics (*ABS classification of occupation – Appendix F*) was significantly associated with fluorosis (Table 9). This significant relation, however, was dependent on the more extreme values associated with the two lowest ranks.

4.3 Predictors of fluorosis

4.3.1 Logistic regression analyses

4.3.1.1 Associations with fluorosis prevalence - FLU2 [Ranks dichotomised as 0 (normal + questionable), 1 (very mild + mild + moderate + severe)]

Univariate logistic regression analyses of FLU2 were associated with *p*-values less than 0.2 for the following variables: age when started brushing with toothpaste; frequency of brushing with toothpaste when toothbrushing commenced; frequency of brushing with toothpaste now; tendency to eat or lick toothpaste when toothbrushing commenced; what child did after toothbrushing now; use of fluoride mouthrinse; years spent in a fluoridated area; infant formula reconstituting agent; and birth weight (Table 10).

Table 7: Distribution of Dean Index ranks by potential explanatory variable FORMIX (Infant formula reconstituting agent)

Dean Index	Tap water (1)		Carbon/charcoal filtered water (2)		Osmosis/distillation filtered water (3)		Mineral/spring water (4)		Tank water (5)		Unknown (6)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	157	22.8	10	35.7	2	14.3	7	31.8	43	32.3	2	33.3
Questionable	241	35.0	3	10.7	3	21.4	7	31.8	54	40.6	3	50.0
Very mild	238	34.5	10	35.7	8	57.1	5	22.7	30	22.6	1	16.7
Mild	41	6.0	5	17.9	1	7.1	2	9.1	5	3.8	0	0.0
Moderate	9	1.3	0	0.0	0	0.0	1	4.6	0	0.0	0	0.0
Severe	3	0.4	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0
Total	689	100	28	100	14	100	22	100	133	100	6	100
CFI	0.70		0.77		0.82		0.70		0.53		0.42	

Missing/excluded data - 460

Chi-square analysis. Categories collapsed as follows:

Categories (1) (2, 3, 4) (5, 6); Dean (0) (1) (2) (3, 4, 5)

Chi-square = 21.3, $p = 0.002$

**Table 8: Distribution of Dean Index ranks by potential explanatory variable ABTS
(Child of Aboriginal or Torres Strait Islander origin)**

Dean Index	No (1)		Aboriginal (2)		Torres Strait Islander (3)		Aboriginal and Torres Strait Islander (4)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	350	27.1	4	12.9	0	0.0	1	50.0
Questionable	437	33.9	13	42.0	1	100.0	0	0.0
Very mild	405	31.4	12	38.7	0	0.0	1	50.0
Mild	79	6.1	0	0.0	0	0.0	0	0.0
Moderate	11	0.9	2	6.5	0	0.0	0	0.0
Severe	7	0.5	0	0.0	0	0.0	0	0.0
Total	1289	100	31	100	1	100	2	100
CFI	0.65		0.79		0.50		0.50	

Missing/excluded data - 29

Chi-square analysis. Categories collapsed as follows:

Categories (1) (2, 3, 4)

Exact test, $p < 0.05$

Table 9: Distribution of Dean Index ranks by potential explanatory variable JOBF (Mother/female guardians job)

Dean Index	Managers and Administrators (1)		Professionals (2)		Associate professionals (3)		Tradespersons (4)		Advanced clerical workers (5)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	16	36.4	15	36.6	96	27.8	16	19.1	48	24.6
Questionable	7	15.9	12	29.3	121	35.0	28	33.3	71	36.4
Very mild	17	38.6	11	26.8	107	30.9	33	39.3	66	33.9
Mild	3	6.8	3	7.3	17	4.9	6	7.1	9	4.6
Moderate	0	0.0	0	0.0	3	0.9	0	0.0	1	0.5
Severe	1	2.3	0	0.0	2	0.6	1	1.2	0	0.0
Total	44	100	41	100	346	100	84	100	195	100
CFI	0.69		0.56		0.63		0.75		0.63	

Table 9 (continued)

Dean Index	Intermediate clerical workers (6)		Intermediate production workers (7)		Elementary clerical workers (8)		Labourers (9)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	39	30.5	1	14.3	7	31.8	9	18.8
Questionable	40	31.3	4	57.1	6	27.3	21	43.8
Very mild	41	32.0	2	28.6	5	22.7	9	18.8
Mild	5	3.9	0	0.0	3	13.6	8	16.7
Moderate	3	2.3	0	0.0	0	0.0	1	2.1
Severe	0	0.0	0	0.0	1	4.6	0	0.0
Total	128	100	7	100	22	100	48	100
CFI	0.63		0.57		0.82		0.80	

Missing/excluded data - 437

Chi-square analysis. Categories collapsed as follows:

Categories (1, 2, 3) (4, 5, 6) (7, 8, 9); Dean (0) (1) (2) (3) (4, 5)

Chi-square = 18.0, $p = 0.02$

Table 10: Odds ratios for very mild or more severe fluorosis. Potential explanatory variables were identified in logistic regression analyses as those showing a univariate association (p<0.2) with FLU2*. Categories shown in bold are reference categories in relation to odds ratio estimates

Explanatory variable	Category	Number	CFI	Odds Ratio	95% CI	p-value
TBAGE (Continuous)	Unit - years	1256	0.66	0.937	(0.86, 1.0)	0.2
Age when started brushing with toothpaste	Missing/excluded data	96	0.64			
TPTIMES1	1. Less than once a day	154	0.54	0.66	(0.45, 0.96)	0.03
Frequency of brushing with toothpaste when toothbrushing commenced	2. Twice a day	516	0.67	0.87	(0.69, 1.1)	0.3
	3. More than twice	16	0.53	0.47	(0.15, 1.5)	0.2
	4. Once a day	620	0.67	.	.	.
	Missing/excluded data	46	0.78			
TPTIMES2	1. Less than once a day	76	0.65	1.3	(0.81, 2.2)	0.3
Frequency of brushing with toothpaste now	2. Twice a day	783	0.67	1.2	(0.91, 1.5)	0.2
	3. More than twice	12	0.46	0.35	(0.08, 1.6)	0.2
	4. Once a day	434	0.63	.	.	.
	Missing/excluded data	47	0.73			
TPLICK1	1. Often	102	0.79	1.8	(1.2, 2.7)	0.008
Child eating or licking toothpaste when toothbrushing commenced	2. Sometimes	507	0.65	0.96	(0.76, 1.2)	0.8
	3. Never	695	0.63	.	.	.
	Missing/excluded data	48	0.79			
TBSPIT2	1. Just swallow	19	1.03	3.5	(1.3, 9.3)	0.01
What child does after toothbrushing now	2. Rinse and swallow	46	0.84	1.8	(0.98, 3.2)	0.06
	3. Just spit	102	0.62	0.97	(0.64, 1.5)	0.9
	4. Rinse and spit	1129	0.65	.	.	.
	Missing/excluded data	56	0.72			
FRIN	1. Yes	109	0.78	1.5	(1.0, 2.3)	0.03
Ever used fluoride mouthrinse	2. Don't know	35	0.71	0.96	(0.48, 1.9)	0.9
	3. No	1188	0.64	.	.	.
	Missing/excluded data	20	0.90			
WF (Continuous)	Unit - years	1319	0.65	1.05	(1.0, 1.1)	0.05
Years spent in a water fluoridated area	Missing/excluded data	33	0.83			
FORMIX	1. Carbon/charcoal filtered water	28	0.77	1.6	(0.74, 3.4)	0.2
Infant formula reconstituting agent	2. Osmosis/distillation filtered water	14	0.82	2.5	(0.82, 7.4)	0.1
	3. Mineral/spring water	22	0.70	0.78	(0.32, 1.9)	0.6
	4. Tank water	133	0.53	0.51	(0.34, 0.77)	0.001
	5. Tap water - mains supply	689	0.70	.	.	.
	Missing/excluded data	466	0.63			
BWK (Continuous)	Unit - kilograms	1193	0.68	0.888	(0.75, 1.0)	0.2
Birth weight	Missing/excluded data	159	0.52			

*Outcome variable FLU2 - Dean fluorosis ranks dichotomised as: 0 (normal, questionable); 1 (very mild, mild, moderate, severe).

The risk of fluorosis was less among those children who brushed less than once a day (OR = 0.66, CI₉₅ 0.45, 0.96) and less among those who had their infant formula reconstituted with tank water (OR = 0.50, CI₉₅ 0.34, 0.77). On the other hand, risk was greater among children who ate or licked toothpaste often (OR = 1.8, CI₉₅ 1.2, 2.7), now swallowed rather than spat out after toothbrushing (OR = 3.5, CI₉₅ 1.3, 9.3), had used fluoride rinses (OR = 1.5, CI₉₅ 1.0, 2.3), and who were exposed to fluoridated water for longer (OR = 1.05, CI₉₅ 1.0, 1.1).

The best fitting multiple regression model identified using backward stepwise variable selection, showed that only the infant formula reconstituting agent was independently predictive of FLU2 (OR = 0.51, CI₉₅ 0.33, 0.78) (Table 11). That is, compared with those having their formula reconstituted with mains supply tap water, children who had had their formula reconstituted with tank water (rain water) were only 50 percent as likely to have very mild or more severe fluorosis.

Table 11: Best fitting multiple logistic regression model identified using backward stepwise variable selection

Outcome variable: FLU2 - Dean fluorosis ranks dichotomised as: 0 (normal, questionable) 1 (very mild, mild, moderate, severe)				
Explanatory variable	Variable category	Odds Ratio	95% CI	p - value
FORMIX* Infant formula reconstituting agent	Carbon/charcoal filtered water	1.7	(0.78, 3.7)	0.2
	Osmosis/distillation filtered water	1.9	(0.60, 6.0)	0.3
	Mineral/spring water	1.1	(0.42, 2.8)	0.9
	Tank water	0.51	(0.34, 0.78)	0.002
	Reference = Mains water supply			

* All other entered variables failed to reach the 0.05 significance level.

4.3.1.2 Associations with fluorosis prevalence - FLU3 [(Ranks dichotomised as 0 (normal + questionable + very mild), 1 (mild + moderate + severe))]

In these univariate analyses using logistic regression, it was shown that FLU3 was associated (using p < 0.2 as the significance level) with the use of fluoride mouthrinse, infant formula reconstituting agent, birth weight, mother’s education and mother’s occupation (Table 12).

The risk of fluorosis was greater among children who had used fluoride rinses (OR = 2.4, CI₉₅ 1.4, 4.4) and greater with the decreasing occupation status of the mother (OR = 1.1, CI₉₅ 1.0, 1.3).

The best fitting multiple regression model (Table 13), identified using backward stepwise variable selection, showed that three variables; use of fluoride rinse (OR = 3.0, CI₉₅ 1.3, 7.1); infant formula reconstituting agent (OR = 6.0, CI₉₅ 1.8, 20.5); and the mother’s occupation (OR = 1.2, CI₉₅ 1.0, 1.4) were independently predictive of FLU3. That is, adjusting for the joint effects of infant formula and mother’s occupation, those children who had used fluoride rinses were three times more likely to have mild or more severe

fluorosis than those who did not use mouth rinses. Similarly, adjusting for the joint effects of the other two predictors respectively, children whose infant formula was reconstituted using carbon/charcoal filtered water were six times more likely to have mild or more severe fluorosis than those whose infant formula was reconstituted with the mains water supply, and children whose mother’s occupation was ranked low were only 20 percent more likely to have mild or more severe fluorosis than those whose mother’s occupation was ranked higher.

Table 12: Odds ratios for mild or more severe fluorosis. Potential explanatory variables were identified in logistic regression analyses as those showing a univariate association (p<0.2) with FLU3*. Categories shown in bold are reference categories in relation to odds ratio estimates

Explanatory variable	Category	Number	CFI	Odds Ratio	95% CI	p-value
FRIN Ever used fluoride mouthrinse	1. Yes	109	0.78	2.4	(1.4, 4.4)	0.2
	2. Don't know	35	0.71	2.4	(0.90, 6.3)	0.4
	3. No	1188	0.64	.	.	.
	Missing/excluded data	20	0.90			
FORMIX Infant formula reconstituting agent	1. Carbon/charcoal filtered water	28	0.77	2.6	(0.95, 7.1)	0.1
	2. Osmosis/distillation filtered water	14	0.82	0.92	(0.12, 7.2)	0.8
	3. Mineral/spring water	22	0.70	1.9	(0.54, 6.6)	0.4
	4. Tank water	133	0.53	0.57	(0.24, 1.3)	0.07
	5. Tap water - mains supply	689	0.70	.	.	.
	Missing/excluded data	466	0.63			
BWK Birth weight (in kilograms)	Continuous unit - years	1193	0.68	1.28	(0.94, 1.8)	0.1
	Missing/excluded data	159	0.52			
EDF Mother/female guardian's education	1. Some high school	206	0.72	1.5	(0.77, 2.9)	0.07
	2. Completed high school	416	0.66	1.1	(0.62, 2.0)	0.5
	3. Some vocational training	95	0.71	1.6	(0.73, 3.6)	0.09
	4. Completed vocational training	150	0.64	1.0	(0.45, 2.2)	1.0
	5. Some University or College	134	0.55	0.31	(0.09, 1.1)	0.02
	6. Completed University or College	282	0.63	.	.	.
	Missing/excluded data	69	0.78			
JOBF Mother/female guardian's job (Categories are ranked as per Australian Bureau of Statistics. Ranks were treated as continuous in model)	1. Managers and administrators	44	0.69	1.136	(1.0, 1.3)	0.05
	2. Professionals	41	0.56			
	3. Associate professionals	346	0.63			
	4. Tradespersons	84	0.75			
	5. Advanced clerical and service	195	0.63	.		
	6. Intermediate clerical and service	128	0.63			
	7. Intermediate production/transport	7	0.57			
	8. Elementary clerical and service	22	0.82			
	9. Labourers	48	0.80			
	Missing/excluded data	437	0.67			

*Outcome variable FLU3 - Dean fluorosis ranks dichotomised as: 0 (normal, questionable, very mild); 1 (mild, moderate, severe).

The odds ratio of 2.6 associated with carbon/charcoal filtered water in the univariate analysis of FLU3 increased unexpectedly to 6.0 in the model, indicating that an important predictor jointly associated with use of the filter had been dropped from the model. This outcome was explored further through cross-tabulation analysis where it was revealed that

14% of children who used carbon/charcoal filtered water had also taken fluoride supplements, compared with only 4% of children on mains supply.

Table 13: Best fitting multiple logistic regression model identified using backward stepwise variable selection

Outcome variable: FLU3 - Dean fluorosis ranks dichotomised as: 0 (normal, questionable, very mild) 1 (mild, moderate, severe)				
Explanatory variable	Variable category	Odds Ratio	95% CI	p-value
FRIN Ever used fluoride mouthrinse	Yes	3.0	(1.3, 7.1)	0.01
	Don't know	3.5	(0.72, 17.0)	0.1
	Reference = No			
FORMIX Infant formula reconstituting agent	Carbon/charcoal filtered water	6.0	(1.8, 20.5)	0.004
	Osmosis/distillation filtered water	0.88	(0.10, 7.4)	0.9
	Mineral/spring water	2.3	(0.49, 11.1)	0.3
	Tank water	0.31	(0.07, 1.3)	0.1
	Reference = Mains water supply			
JOBF Mother/female guardian's job (Categories are ranked as per Australian Bureau of Statistics. Ranks were treated as continuous in the model)	1. Managers and administrators	1.2	(1.0, 1.4)	0.01
	2. Professionals			
	3. Associate professionals			
	4. Tradespersons			
	5. Advanced clerical and service			
	6. Intermediate clerical and service			
	7. Intermediate production/transport			
	8. Elementary clerical and service			
	9. Labourers			

4.4 Reliability of measurements

Inter-examiner kappa values, unweighted, ranged from 0.88 at the beginning of the survey to 0.95 by the end of the survey. Weighted values for inter-examiner reliability ranged from 0.92 initially to 0.96 finally.

For intra-examiner reliability, unweighted kappa values ranged from 0.95 at the beginning of the survey to 1.0 by the end of the survey. Weighted kappa values ranged from 0.96 initially to 1.0 finally.

(Kappa value calculations – Appendix H)

5. Discussion

The analysis was dependent upon data obtained by questionnaire, some of which related to events that occurred five or more years previously, and is therefore subject to the unreliable recollection of parents, and hence misclassification error.

The CFI values of male and female children in this study were not significantly different (Table 4), therefore the results were not shown separately for the two groups (*Supplement: Table S2*).

5.1 Fluorosis and water fluoridation

The prevalence of fluorosis in the present study was found to be higher (0.39) than what is expected in an optimally fluoridated area (Dean and Elvove, 1935). This higher prevalence has also been observed in other studies conducted in fluoridated areas in Australia. In Perth, Riordan (1991 and 1993) reported a prevalence of 0.40 for the 12-year-olds and 0.48 for the 7-year-olds. In another study in South Australia, Puzio and Spencer (2001) reported a higher than expected prevalence of 0.35 for children aged 10 to 17 years. Elsewhere in the world, a number of studies have also found the prevalence of fluorosis to be on the rise in fluoridated areas. Of the more recent studies, Loh (1996) found the prevalence of fluorosis in Singapore to be 0.38 for children aged 11 to 13 years. In Connecticut USA, Pendrys (2000) observed the prevalence of fluorosis to be 0.34 for children aged 10 to 14 years. Another study in the USA (Griffin *et al.*, 2002), calculated the prevalence of fluorosis to be 0.33 for children aged 12 to 14 years. In Ireland, Whelton *et al.* (2004) stated that the prevalence of fluorosis has increased significantly between 1984 (0.05) and 2002 (0.24). On the other hand, fluorosis prevalence (0.15) has been found to be within the expected range among children in a recent Melbourne study (Evans *et al.*, 1998) and this corresponded with results (fluorosis prevalence 0.04) from the Goldfields of Western Australia (Medcalf, 1975) and in Tamworth, NSW where Barnard (1995) found the prevalence of fluorosis to be very low; 0.04 in 1988 for the 12-year-olds.

The significant difference in the proportions of normal and questionable cases between the two regions, Blue Mountains and Hawkesbury, is of academic consequence only. The difference was the variation in the distributions of the normal and questionable categories

in the two regions. Since the "questionable" category is regarded as a non-case, fluorosis prevalence, therefore, is calculated on the basis of individuals showing signs of at least very mild fluorosis. The variation in normal and questionable could have been related to a diagnostic shift during the early stages of the survey, or to variation in the percentage of the sample on tank water in each region.

The target fluoride concentration for drinking water in Sydney is set at 1 ppm. The determination of an optimal concentration depends on climatic conditions, especially ambient temperature. Galagan & Vermillion (1957) calculated, on the basis of data on water consumption in the United States of America, that an optimal fluoride concentration for communities, such as Sydney, where the mean maximum daily temperature is 23.4 degrees Centigrade (mean over 146 years), is between 0.7 and 0.8 ppm. The reason for the climatic difference is that fluid intake in hotter climates is greater than that in colder climates, and consequently, the fluoride dose in hotter climates is greater. The report of the Sydney Water Corporation, 2000 showed that in 1999 the mean fluoride concentration maintained in Sydney water was 1.1 ppm, this value is 57 and 38 percent higher than the target values of 0.7 and 0.8 ppm respectively.

Most studies demonstrate that longer exposure to fluoridated water during the years of tooth development is associated with a higher fluorosis risk, but this association was not found in this study. In fact, the data tended to support the reverse situation. Similarly, the CFI for children exposed to lifelong fluoridated water and the CFI for the combined group of children who had no lifetime exposure to fluoridated water or had part lifetime exposure to fluoridated water was 0.66 in both cases. These results are not easily explained unless the data, derived from historical recollection, were subject to serious misclassification error. It has been shown that water borne fluoride is the primary source of dietary fluoride and has been found to contribute about 0.3 mg F/day to the diet of a 2-year-old living in an area fluoridated at 1.0 ppm (NHMRC, 1991). Levy *et al.* (1995) observed that 10 percent of infants, irrespective of their age group, living in a fluoridated area consume more than what is considered as the threshold for fluorosis development.

5.2 Fluorosis and toothpaste use

The interest in toothbrushing history centred on the evidence in the literature review showing that early exposure to ingested toothpaste is an important fluorosis risk factor. It was expected that child age at the commencement of toothbrushing would be associated with fluorosis severity, but this was not the case (Table 4). More than 70 percent of children were brushing by two years of age, a time when the majority of the paste would be swallowed, and about half of the children with mild to severe fluorosis reportedly ate or liked toothpaste when brushing started (Appendix G –Table F11). Also, 70 percent of children with mild to severe fluorosis started with a low formulation fluoride toothpaste (Appendix G –Table F9). Because such a high proportion of children during the years of tooth formation were brushing regularly the results show a reduced risk for those brushing less than once a day (Table 10).

Ripa (1991) reviewed 10 studies which examined fluorosis and toothpaste use by small children, and found that only one of the studies demonstrated this risk (OR = 11, Osuji *et al.*, 1988). Fluoride toothpaste use in Australia increased dramatically after 1972 (Barnard, 1995), and Riordan (1991 and 1993a) found that toothpaste was liked by around 85 percent of children he examined. He reported that swallowing of toothpaste was a significant risk factor for fluorosis. In our study, we checked for this association and found that there was a significant risk for children who, at the time of examination, did not rinse or spit out after brushing but not, as reported, when they first started brushing.

It has been shown that a major part of daily fluoride intake, 0.5 mg, for infants is from toothpaste with 1000 ppm fluoride (NHMRC, 1991). Brushing with fluoride toothpaste once daily has been found to increase the daily fluoride intake by 50 percent and if brushing occurred twice daily then the daily fluoride intake doubled to 1.0 mg (Whitford, 1996). It has been reported that ingestion of fluoridated toothpaste caused the total fluoride intake of some infants in a fluoridated area to exceed the optimal level of 0.05-0.07 mg F/kg body weight (Chowdhury *et al.*, 1990). Recently, toothpaste use in Indiana, USA was found to provide a significant proportion of daily fluoride intake among children aged 16 to 40 months, and ingestion was found to be above the recommended upper threshold limit of 0.07 mg/F/kg/day in the fluoridated areas (Rojas-Sanchez *et al.*, 1999). It has also been reported that the higher the concentration of fluoride in toothpaste, the greater the risk for

fluorosis and that “72 percent of toothpaste applied to the toothbrush was retained in the mouth and presumably ingested” (Bentley *et al.*, 1999). Mascarenhas and Burt (1998) reported that toothpaste use before 6 years of age was a risk indicator for fluorosis (OR = 1.8), and Pendrys (2000) reported that two-thirds of cases of fluorosis among 10 to 14-year-olds in fluoridated areas could be attributed to early toothpaste use. He also reported that, 46 percent of cases could be attributed to the combination of using more than a pea-sized amount of toothpaste, and brushing more than once per day.

5.3 Fluorosis and fluoride supplements

A significant association between fluorosis and fluoride supplement ingestion was not found in the present survey, and none of the children ranked as having moderate or severe fluorosis had consumed fluoride supplements. However, in Perth, Riordan and Banks (1991) observed that fluoride supplements were a risk factor for fluorosis (OR = 4.63). Pendrys (2000) suggested that around 13 percent of cases of fluorosis in a fluoridated area were due to the use of fluoride supplements. It is noteworthy that Riordan (2002) reported fluorosis prevalence in Western Australia had been reduced by almost 50 percent following health promotion advice that fluoride tablets should not be used by children living in fluoridated areas, and that only a smear of toothpaste (low fluoride formulation) should be dispensed for children.

5.4 Fluorosis and fluoride mouthrinse

Children using fluoride mouthrinses were three times more likely to have fluorosis than children who never used fluoride mouthrinses. When this relation was further analysed, it was found that 17 percent of these children started rinsing before the age of 5 years. It was also found that 28 percent of children who used mouthrinses belonged to families in which the mother's occupation was under the category of associate professionals. It is noted that 25 percent of all cases of moderate and severe fluorosis belong to such families. Regarding this risk, Whitford (1996) reported that rinsing once daily with 0.05 percent sodium fluoride solution is likely to result in the ingestion of 0.25 mg/F/day and 0.5 mg/F/day if rinsing occurred twice, greatly elevating risk of exceeding threshold levels.

5.5 Fluorosis and infant formula use

The reconstitution of infant formula with fluoridated water (mains water) was identified as a weak risk factor in the univariate analysis. Other reconstituting agents were tank water (rain water) and bottled water of various types, the fluoride content of which was unknown – it could have been high or low. In Australia, Silva and Reynolds (1996) reconstituted several infant formula products with water containing 1.0 ppm fluoride and showed that it provided a daily fluoride intake of two to three times the recommended upper limit of 0.07 mg F/kg body weight. They suggested that infant formula reconstituted with optimally fluoridated water was a risk factor for fluorosis. Pendrys (2000) showed that 9 percent of fluorosis cases in a fluoridated area could be explained by the use of infant formula. Buzalaf *et al.* (2001) conducted a study on reconstituted infant formula in Brazil. They reported that almost all samples of infant formula reconstituted with 1.0 ppm fluoridated water provided a daily intake of fluoride above the suggested threshold of 0.1 mg F/kg for fluorosis, and concluded that use of fluoridated water to reconstitute infant formula should be avoided.

In our multivariate analysis, those children whose infant formula was reconstituted with water that had been filtered through a charcoal/carbon filter were greatly more at risk than those whose formula was reconstituted with mains water (OR=6.0). Not only are filters of this type very ineffective in removing fluoride (www.ada.org/public/topics/documents/art_water_home.pdf; www.gem.msu.edu/pubs/msue/wq23p1.html; www.home-water-purifiers-and-filters.com/carbon-water-filter.php), but we found that 14 percent of these children had been given fluoride supplements compared with only four percent of those on mains supply. This analysis indicated that, in this group, the greater fluorosis risk was attributable to issues related to fluoride tablet use.

Furthermore, children (n=133) whose infant formula was reconstituted with tank water (rain water) were 50 percent less likely to get fluorosis than children whose infant formula was reconstituted with mains supply (Table 11). Such children were otherwise not exposed to fluoridated domestic water.

5.6 Summary

The overall CFI value in this study was 0.66 which, according to Dean, is within the range that warrants a public health concern. In our study, it was observed that 70 percent of children started brushing their teeth with toothpaste before the age of 2 years (*Supplement: Table S3*), and also that 70 percent of the children examined had lifelong exposure to fluoridated water (Appendix G – Table F43). This early exposure to fluoride coincides with the window of increased susceptibility to fluorosis, 15 to 30 months of age (Evans and Darvell, 1995), when maxillary central incisors are entering the early maturation stage of enamel development where, in an environment of elevated fluoride, the resultant enamel becomes fluorosed (Den Besten, 1999).

Despite detailed searching of the data, there appeared to be no particular exposure that explained the cases of moderate and severe fluorosis, and it is concluded that these cases fall within a normal population distribution, indicating that the overall fluoride exposure among children in this region is too high.

The major points arising from this study are that:

1. The Community Fluorosis Index (CFI) for the combined Blue Mountains and Hawkesbury regions was 0.66.
2. Seventy percent of children started brushing their teeth with toothpaste by the age of 2 years.
3. Seventy percent of the children examined had lifelong exposure to fluoridated water.
4. Children using tank water as the domestic source were 50 percent less likely to have fluorosis.
5. Children using fluoride mouthrinses were three times more likely to have fluorosis – 17 percent of these children commenced rinsing before the age of 5 years.
6. None of the children with moderate or severe fluorosis had ever used fluoride tablets, drops, or rinses.

It is concluded that the higher than expected prevalence and severity of fluorosis was due mainly to the combined risk posed by the fluoridated water and toothpaste, and for a few individuals, contributing risks are exposure to fluoride rinses and tablets.

5.7 Recommendations

It is recommended that:

1. Fluoride supplements, in lozenge formulation, should be restricted to individuals known to be at risk of caries in non-fluoridated areas.
2. The use of fluoridated toothpaste should only be used by children younger than age 2 years only if they are known to be at risk of caries, in which case its use has both important curative and preventive effects.
3. The use of fluoridated toothpaste for preventive purposes by children not known to be at risk of caries should not be encouraged until they are aged 2 years, and its use should be strictly managed by parents to observe that:
 - only a low fluoride formulation toothpaste should be dispensed
 - only a parent should dispense the toothpaste
 - only a smear is dispensed
 - the toothpaste is stored out of reach of children
4. Pre-school children should not use fluoride mouthrinse.
5. Health education messages concerning the informed use of fluoride in caries prevention need to be developed and delivered via appropriate channels.
6. Consideration be given to reducing the target fluoride concentration in Sydney water to a level that is consistent with targets elsewhere based on similar climatic conditions.

References

1. Ainamo J, Cutress TW. An epidemiological index of developmental defects of dental enamel (DDE Index). *International Dental Journal*. 32(2):159-67, 1982.
2. Al-Alousi W, Jackson D, Crompton G, Jenkins OC. Enamel mottling in a fluoride and in a non-fluoride community. A study. *British Dental Journal*. 138(1):9-15, 1975.
3. Altree-Williams S. Water fluoridation in New South Wales, 1956-1971. *Australian Dental Journal*. 17(3): 196-203, 1972.
4. Anon. Fluoridation in Sydney. *Australian Dental Journal*. 13(4): 314, 1968.
5. Barnard PD. Changes in fluorosis of Tamworth school children 32 years after fluoridation. *Unpublished manuscript. Barnard Library, Westmead Hospital*. 1995.
6. Barnard PD. Communities fluoridated in Australia, 1968. *Australian Dental Journal*. 14(6): 392-5, 1969.
7. Barrett MJ. Dental observations on Australian Aborigines: water supplies and endemic dental fluorosis. *Australian Journal of Dentistry*. 1: 2, 87-92, 1956.
8. Bentley EM, Ellwood RP, Davies RM. Fluoride ingestion from toothpaste by young children. *British Dental Journal*. 186(9): 460-2, 1999.
9. Buzalaf MA, Granjeiro JM, Damante CA, de Ornelas F. Fluoride content of infant formulas prepared with deionised, bottled mineral and fluoridated drinking water. *Journal of Dentistry for Children*. 68(1): 37-41, 10, 2001.
10. Carr LM. Fluoridation in Canberra. I. Prefluoridation data: dental caries and mottled enamel. *Australian Dental Journal*. 11(4): 248-57, 1966.

11. Chowdhury NG, Brown RH, Shepherd MG. Fluoride Intake of Infants in New Zealand. *Journal of Dental Research*. 69(12):1828-33, 1990.
12. Cutress TW, Suckling GW. Differential diagnosis of dental fluorosis. *Journal of Dental Research*. 69 Spec No: 714-20; discussion 721, 1990.
13. Davies GN, Kruger BJ, Homan BT. Dental survey of children in country districts of Queensland. *Australian Dental Journal*. 14(3): 153-61, 1969.
14. Dean HT, Arnold Jr FA, Elvove E. Domestic Water and Dental Caries. V. Additional studies of the relation of fluoride domestic waters to dental caries experience in 4,425 white children aged 12 to 14 years, of 13 cities in 4 states. *Public Health Reports*. 57:1155-1179, 1942.
15. Dean HT, Elvove E. Further Studies on the Minimal Threshold of Chronic Endemic Dental Fluorosis. *Public Health Reports*. 52:1249-1264, 1937.
16. Dean HT, Elvove E. Studies on the Minimal Threshold of the Dental Sign of Chronic Endemic Fluorosis (Mottled Enamel). *Public Health Reports*. 50:424-442, 1935.
17. Dean HT. Classification of Mottled Enamel Diagnosis. *Journal of American Dental Association*. 21:1421-1426, 1934.
18. Dean HT. Epidemiological studies in the United States. In: Moulton FR, ed. *Dental Caries and Fluorine*, Washington DC: American Association for the Advancement of Science. 5-31, 1946.
19. Dean HT. The investigation of physiological effects by the epidemiological method. In: Moulton FR, ed. *Fluorine and Dental Health*. Washington DC: American Association for the Advancement of Science. 23-31, 1942.

20. Den Besten PK. Mechanism and timing of fluoride effects on developing enamel. *Journal of Public Health Dentistry*. 59(4): 247-51, 1999.
21. Evans RW, Bedi R, Lind OP. Determining treatment needs for primary teeth during epidemiological surveys. *Community Dental Health*. 4(1): 49-58, 1987.
22. Evans RW, Darvell BW. Refining the estimate of the critical period for susceptibility to enamel fluorosis in human maxillary central incisors. *Journal of Public Health Dentistry*. 55(4):238-49, 1995.
23. Evans RW, Morgan M, Conn J. Dental fluorosis prevalence in Melbourne 12-year-olds is within expected limits. *IADR, ANZ Division*, Sept 1998.
24. Evans RW, Stamm JW. An epidemiologic estimate of the critical period during which human maxillary central incisors are most susceptible to fluorosis. *Journal of Public Health Dentistry*. 51(4): 251-9, 1991a.
25. Evans RW, Stamm JW. Dental fluorosis following downward adjustment of fluoride in drinking water. *Journal of Public Health Dentistry*. 51(2):91-8, 1991b.
26. Evans RW. *An epidemiological study of the effect of variation in fluoride exposure on dental fluorosis*. DDSc Thesis, University of Otago, 1995.
27. Fejerskov O, Manji F, Baelum V, Møller IJ. *Dental Fluorosis – a handbook for health workers*. Munksgaard, Copenhagen. pp 33-40, 78-85. 1988.
28. Fejerskov O, Thylstrup A, Larsen M. Clinical and structural features and possible pathogenic mechanisms of dental fluorosis. *Scand J Dent Res*. 85:510, 1977.
29. Galagan DJ, Vermillion JR. Determining optimum fluoride concentrations. *Public Health Reports*. 72:491-93, 1957.

30. Griffin SO, Beltran ED, Lockwood SA, Barker LK. Esthetically objectionable fluorosis attributable to water fluoridation. *Community Dentistry & Oral Epidemiology*. 30(3):199-209, 2002.
31. Hawley GM, Ellwood RP, Davies RM. Dental caries, fluorosis and the cosmetic implications of different TF scores in 14-year-old adolescents. *Community Dental Health*. 13(4):189-92, 1996.
32. Horowitz HS, Driscoll WS, Meyers RJ, Heifetz SB, Kingman A. A new method for assessing the prevalence of dental fluorosis--the Tooth Surface Index of Fluorosis. *Journal of the American Dental Association*. 109(1): 37-41, 1984.
33. Ishii T, Suckling G. The appearance of tooth enamel in children ingesting water with a high fluoride content for a limited period during early tooth development. *Journal of Dental Research*. 65(7):974-7, 1986.
34. Kailis DG, Silva DG. Carnarvon studies. 3. Detailed investigations related to endemic dental fluorosis present in children in Carnarvon, Western Australia (August 1963). *Australian Dental Journal*. 15(1): 35-43, 1970a.
35. Kailis DG, Silva DG. Carnarvon studies. I. Endemic fluorosis present in children in Carnarvon, Western Australia (August, 1963). *Australian Dental Journal*. 12(4): 304-9, 1967.
36. Kailis DG, Silva DG. Occurrence of dental fluorosis in Australian Aboriginal children resident in Carnarvon, Western Australia. *Australian Dental Journal*. 15(3): 216-24, 1970b.
37. Kailis DG. Dental conditions observed in Australian Aboriginal children resident in Warburton and Cundeelee missions, Western Australia (August, 1968). *Australian Dental Journal*. 16(1): 44-52, 1971.

38. Kumar JV, Swango PA, Opima PN, Green EL. Dean's fluorosis index: an assessment of examiner reliability. *Journal of Public Health Dentistry*. 60(1): 57-9, 2000.
39. Levy SM, Kohout FJ, Guha-Chowdhury N, Kiritsy MC, Heilman JR, Wefel JS. Infants' fluoride intake from drinking water alone, and from water added to formula, beverages, and food. *Journal of Dental Research*. 74(7): 1399-407, 1995.
40. Loh T. Thirty-eight years of water fluoridation--the Singapore scenario. *Community Dental Health*. 13 Suppl 2:47-50, 1996.
41. Mascarenhas AK, Burt BA. Fluorosis risk from early exposure to fluoride toothpaste. *Community Dentistry & Oral Epidemiology*. 26(4): 241-8, 1998.
42. Medcalf GW. Six years of fluoridation on the goldfields of Western Australia. *Australian Dental Journal*. 20(3): 170-3, 1975.
43. National Health and Medical Research Council (NHMRC). *The Effectiveness of Water Fluoridation*. Australian Government Publishing Service, Canberra. pp 122-6. 1991.
44. Ophaug RH, Singer L, Harland BF. Dietary fluoride intake of 6-month and 2-year-old children in four dietary regions of the United States. *American Journal of Clinical Nutrition*. 42(4): 701-7, 1985.
45. Osuji OO, Leake JL, Chipman ML, Nikiforuk G, Locker D, Levine N. Risk factors for dental fluorosis in a fluoridated community. *Journal of Dental Research*. 67(12):1488-92, 1988.
46. Patterson AF, Weidenhofer RNG. A study of the dental health of primary school children in the local government areas of the Blue Mountains and Hawkesbury NSW, 1993. *Dental Health Unit, NSW Department of Health*. 1993.

47. Pendrys DG. Risk of enamel fluorosis in non-fluoridated and optimally fluoridated populations: considerations for the dental professional. *Journal of the American Dental Association*. 131(6): 746-55, 2000.
48. Pendrys DG. The fluorosis risk index: a method for investigating risk factors. *Journal of Public Health Dentistry*. 50(5): 291-8, 1990.
49. Puzio A, Spencer AJ. Risk factors and prevalence of Dental Fluorosis in South Australia. *Journal of Dental Research*. 80: 977, 2001 (Abstract number 214).
50. Riordan PJ, Banks JA. Dental fluorosis and fluoride exposure in Western Australia. *Journal of Dental Research*. 70(7): 1022-8, 1991.
51. Riordan PJ. Dental fluorosis decline after changes to supplement and toothpaste regimens. *Community Dentistry & Oral Epidemiology*. 30(3):233-40, 2002.
52. Riordan PJ. Dental fluorosis, dental caries and fluoride exposure among 7-year-olds. *Caries Research*. 27(1):71-7, 1993a.
53. Riordan PJ. Perceptions of dental fluorosis. *Journal of Dental Research*. 72(9): 1268-74, 1993b.
54. Riordan PJ. Specialist clinicians' perceptions of dental fluorosis. *Journal of Dentistry for Children*. 60(4-5): 315-20, 1993c.
55. Ripa LW. A Critique of Topical Fluoride Methods (Dentifrices, Mouthrinses, Operator and Self-applied Gels) in an Era of Decreased Caries and Increased Fluorosis Prevalence. *Journal of Public Health Dentistry*. 51:23-41, 1991.
56. Rojas-Sanchez F, Kelly SA, Drake KM, Eckert GJ, Stookey GK, Dunipace AJ. Fluoride intake from foods, beverages and dentifrice by young children in communities with negligibly and optimally fluoridated water: a pilot study. *Community Dentistry & Oral Epidemiology*. 27(4): 288-97, 1999.

57. Russell AL. The differential diagnosis of fluoride and nonfluoride enamel opacities. *Journal of Public Health Dentistry*. 21: 143-146, 1961.
58. Silva M, Reynolds EC. Fluoride content of infant formulae in Australia. *Australian Dental Journal*. 41(1): 37-42, 1996.
59. Spencer AJ, Slade GD, Davies M. Water fluoridation in Australia. *Community Dental Health*. 13 Suppl 2:27-37, 1996.
60. Thylstrup A, Fejerskov O. Clinical Appearance of Dental Fluorosis in Permanent Teeth in Relation to Histological Changes. *Community Dentistry & Oral Epidemiology*. 6: 315-328, 1978.
61. Treasure ET, Chestnutt IG, Whiting P, McDonagh M, Wilson P, Kleijnen J. The York review--a systematic review of public water fluoridation: a commentary. *British Dental Journal*. 192(9): 495-7, 2002.
62. Whelton H, Crowley E, O'Mullane D, Donaldson M, Kelleher V, Cronin M. Dental caries and enamel fluorosis among the fluoridated and non-fluoridated populations in the Republic of Ireland in 2002. *Community Dental Health*. 21(1):37-44, 2004.
63. Whitford GM. *The metabolism and toxicity of fluoride, 2nd revised edition*. Monographs in oral science, Volume 16, Myers HH (Editor). Basel: Karger. pp 1-9. 1996.
64. WHO. *Appropriate use of fluorides for human health*. World Health Organisation, Geneva. pp 16-21. 1986.
65. WHO. *Oral Health Surveys: Basic Methods, 4th Edition*. World Health Organisation, Geneva. pp 35-6. 1997.

66. WHO. The World Oral Health Report 2003. *Continuous Improvement of Oral Health in the 21st Century – The Approach of the WHO Global Oral Health Programme*. World Health Organisation, Geneva. pp 19. 2003.
67. Williamson JJ, Barrett MJ. Oral health of Australian Aborigines: endemic dental fluorosis. *Australian Dental Journal*. 17(4): 266-8, 1972.
68. World Wide Web – 2004
- www.ada.org/public/topics/documents/art_water_home.pdf
 - www.bmcc.nsw.gov.au
 - www.gem.msu.edu/pubs/msue/wq23p1.html
 - www.hawkesbury.nsw.gov.au
 - www.home-water-purifiers-and-filters.com/carbon-water-filter.php

Appendices

Appendix A: Map of Blue Mountains and Hawkesbury

Appendix B: Ethics approval

Appendix C: Information package for school principals

Appendix D: Information package for parents

Appendix E: Questionnaire

Appendix F: ABS classification of occupation

Appendix G:

- Contingency tables of bivariate analyses of fluorosis by individual explanatory variables
- Analysis of variance tables for continuous explanatory variables

Appendix H: Kappa value calculation tables

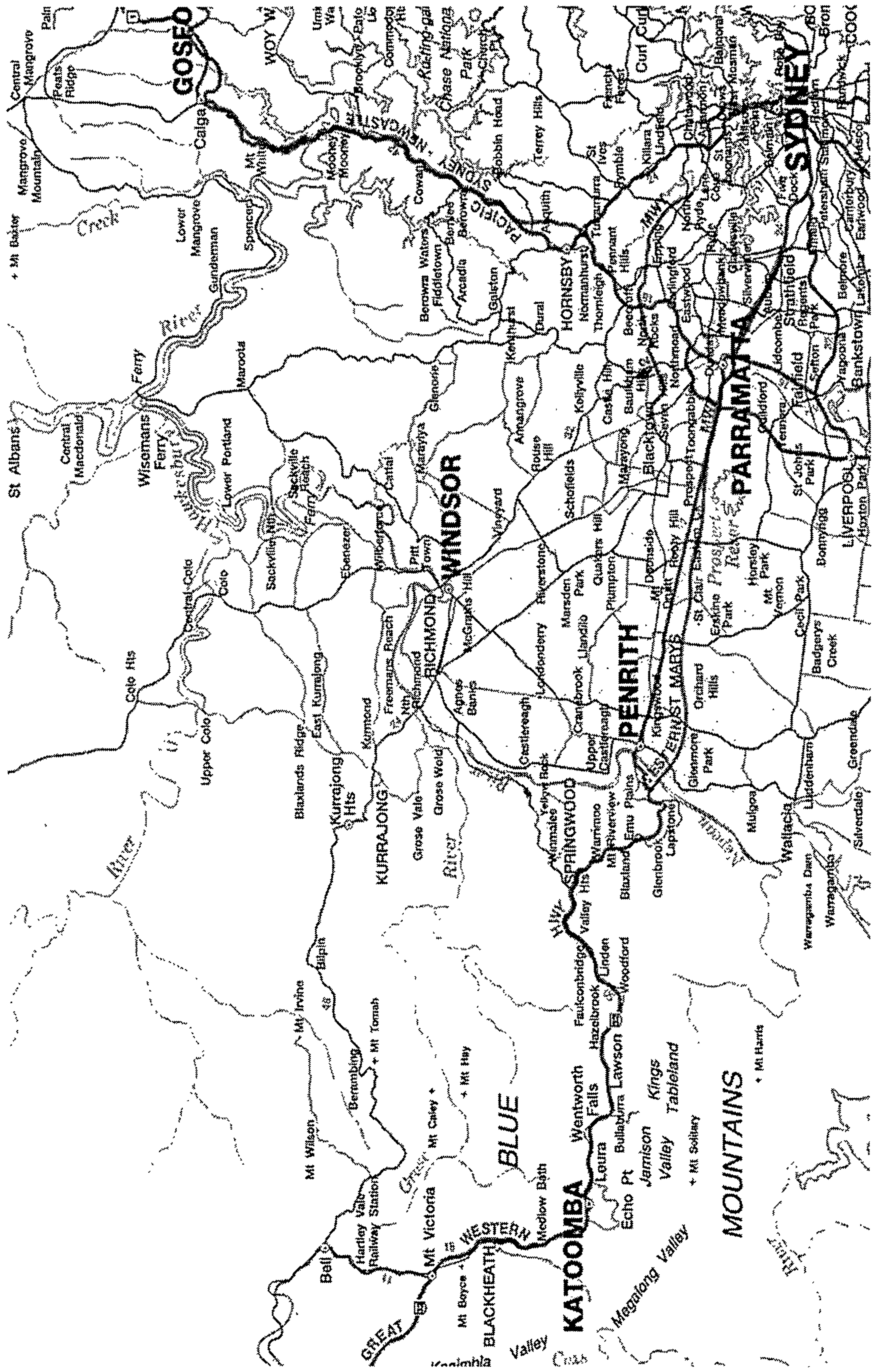
Appendix I: Russell's differential diagnosis criteria for fluorosis

Appendix J: Photographic examples of Dean Index ranks

Supplement

Appendix A: Map of Blue Mountains and Hawkesbury

Map of Blue Mountains and Hawkesbury



Appendix B: Ethics approval



The University of Sydney

NSW 2006 Australia

24 March 2003

Dr W Evans
Community Oral Health and Epidemiology
Faculty of Dentistry
Westmead Centre for Oral Health
C24

Dear Dr Evans

Thank you for your correspondence dated 19 March 2003 addressing comments made to you by the Committee. After considering the additional information, the Executive Sub-Committee at its meeting on 20 March 2003 approved your protocol on the study below subject to the following condition. Please note that subject to annual monitoring returns, the approved protocol is valid for five years.

Title: *Child Oral Health Survey of the Blue Mountains and Hawkesbury Regions*
Ref No: 6725
Approval Period: 20 March 2003 – 20 March 2004
Authorised Personnel: *Dr Wendell Evans*
Dr Peter Dennison
Dr Shanti Sivaneswaran

Condition

- Approval from the Department of Education is required before the commencement of the study.

The additional information will be filed with your application.

In order to comply with the *National Statement on Ethical Conduct in Research Involving Humans*, and in line with the Human Research Ethics Committee requirements the Chief Investigator's responsibility is to ensure that:

- (1) The individual researcher's protocol complies with the final and Committee approved.
- (2) Modifications to the protocol cannot proceed until such approval is obtained in writing.

Human Research Ethics Committee

Manager:

Mrs Gail Briody

Telephone: (02) 9351 4811

(02) 9351 4474

Facsimile: (02) 9351 6706

Email: gbriody@mail.usyd.edu.au

Rooms L4.14 & L4.13 Main Quadrangle A14

Human Secretariat

Telephone: (02) 9036 9309

(02) 9036 9308

Facsimile: (02) 9036 9310

Email: r.todd@reschols.usyd.edu.au

m.williams@reschols.usyd.edu.au

- (3) The confidentiality and anonymity of all research subjects is maintained at all times, except as required by law.
- (4) All research subjects are provided with a Participant Information Sheet and Consent Form, unless otherwise agreed by the Committee.
- (5) The Participant Information Sheet and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee.
- (6) The following statement must appear on the bottom of the Participant Information Sheet. *Any person with concerns or complaints about the conduct of a research study can contact the Manager of Ethics Administration, University of Sydney, on (02) 9351 4811.*
- (7) The standard University policy concerning storage of data and tapes should be followed. While temporary storage of data or tapes at the researcher's home or an off-campus site is acceptable during the active transcription phase of the project, permanent storage should be at a secure, University controlled site for a minimum of five years.
- (8) A progress report should be provided by the end of each year. Failure to do so will lead to withdrawal of the approval of the research protocol and re-application to the Committee must occur before recommencing.
- (9) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely



Associate Professor Stewart Kellie
Chairman, Human Research Ethics Committee

(encl. 2)



Early Childhood and Primary Education
Secondary Education
Technical and Further Education
Vocational Education and Training
Higher Education
Adult and Community Education

Associate Professor Wendall Evans
Community Oral Health and Epidemiology
Westmead Oral Health Centre
Westmead Hospital
WESTMEAD NSW 2145

Dear Associate Professor Evans

SERAP Number: 03.39

I refer to your application to conduct a research project in NSW government schools entitled *Survey of child oral health in the Blue Mountains and Hawkesbury Regions*. I am pleased to inform you that your application has been approved. You may now contact the Principals of the nominated schools to seek their participation.

This approval will remain valid until 19/05/2004.

You should include a copy of this letter with the documents you send to schools. I draw your attention to the following requirements for all researchers in NSW government schools:

- School Principals have the right to withdraw the school from the study at any time. The approval of the Principal for the specific method of gathering information for the school must also be sought.
- The privacy of the school and the students is to be protected.
- The participation of teachers and students must be voluntary and must be at the school's convenience.
- Any proposal to publish the outcomes of the study should be discussed with the Research Approvals Officer before publication proceeds.

When your study is completed please forward your report marked to Strategic Research Directorate, Department of Education and Training, Level 6, 35 Bridge Street, Sydney, NSW 2000.

Yours sincerely



For Dr Paul Brock
Director of Strategic Research
20 May 2003



Wentworth Area Health Service

HUMAN RESEARCH ETHICS COMMITTEE

ETHICS COMMITTEE

Mr. George Truman
Prof. Lesley Wilkes
Br. Julian Liddiard
Mr. Vittorio Cintio
Mr. Graeme Renshaw
Fr. Tim Hogan
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Ms. Jenny O'Baugh
Dr. Bertram Canagasingham

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Ms. Jenny Apps

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SUB-COMMITTEE

Dr. Jenny Shannon
Prof. Jim Wiley
Mr. George Truman
Dr. Jim Kalantar
Ms. Hannah Liao-Loon
Ms. Sally O'Brien
Dr. Ian Seppelt

1st May, 2003

A/Prof. Wendell Evans
Faculty of Dentistry
C24 Westmead Centre for Oral Health
Westmead NSW 2145

Dear Prof. Evans,

03/018

**Child Oral Health Survey of the Blue
Mountains and Hawkesbury Regions - A/Prof.
Wendell Evans, Dr. Peter Dennison, Dr. Shanti
Sivaneswaran**

Thank you for your response dated April 12th, addressing the queries of the Committee and making the required amendments.

I am pleased to inform you that your project has now been approved.

This approval is valid for a period of 12 months from the date of this letter.

Conditions of this approval are that the Committee be kept informed of:

1. Any serious or unexpected adverse events involving participants;
2. Changes to the research protocol (including if the project is not commenced, or is delayed in commencement by more than six months from the date of this letter; or is discontinued and giving reasons)
3. All current Nepean Hospital/Area policies pertaining to the project must be fully complied with. *These policies include, Duty of Care, Infection Control and Occupational Health and Safety.*

In addition, the Committee is to be provided with immediate reports of any unforeseen events that might affect the ethical acceptability of the project.

Please note that twelve-monthly Progress Reports should also be submitted to the Committee.

The project approval becomes operative when the attached copy of this letter is signed, dated and returned to Marietta Coutinho, Area Ethics Officer, Court Building, WAHS.

Should you have any queries, please contact Marietta Coutinho, WAHS Ethics Officer, on 47 34 3441.

The Committee wishes you success in the project.

Yours sincerely,

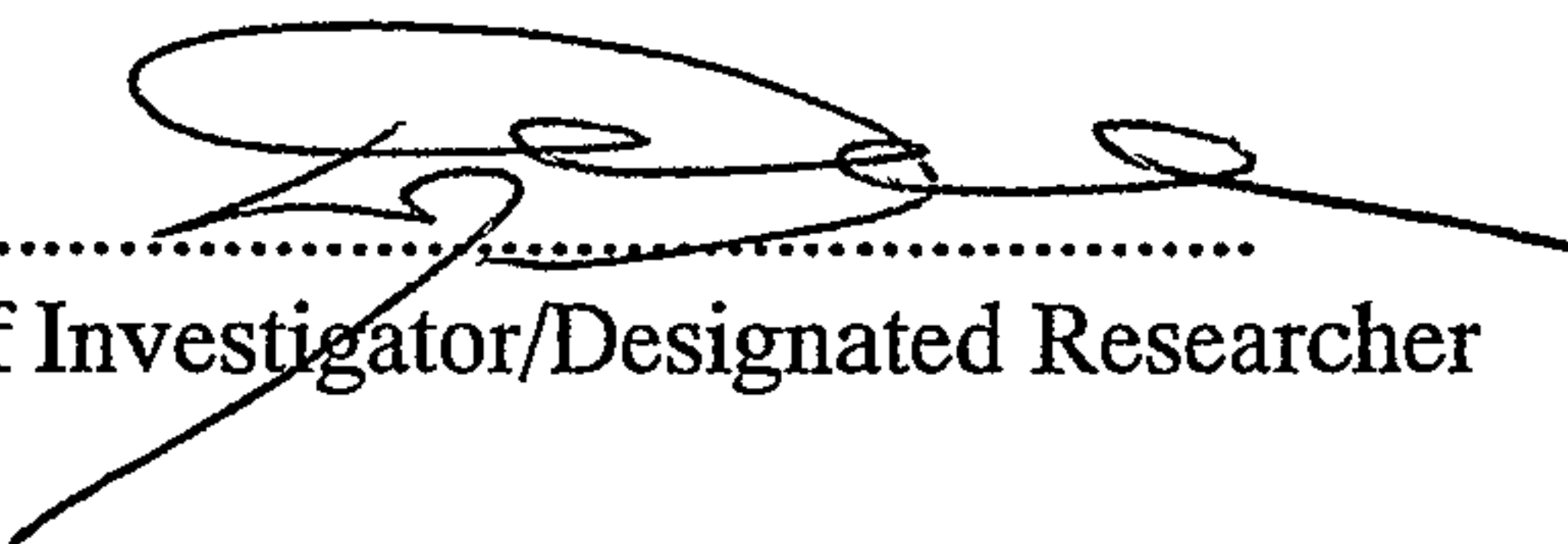


George Truman

Chairperson WAHS Ethics Committee

CC: Dr. Peter Dennison, Faculty of Dentistry, C24 Westmead Centre for Oral Health, Westmead NSW 2145
Ms. Marie Wheatley, WAHS Oral Dental Health Clinic.

I accept, acknowledge and will comply with the conditions of approval for this project.


.....
Chief Investigator/Designated Researcher

2 - 5 - 02
.....
(Date)

Appendix C: Information package for school principals



The University of Sydney



**Wentworth Area
Health Service**

**Faculty of Dentistry
College of Health Sciences**

Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology
Westmead Centre for Oral Health
Phone 9845 7537
E-mail: w.evans@dentistry.usyd.edu.au

**Oral Health Services
School Assessment Program**

Marie Wheatley
Area Director
Ph 4734 3380
E-mail: wheatlm@wahs.nsw.gov.au

May 2003

NAME AND ADDRESS OF SCHOOL HERE

Dear Principal

Child Oral Health Survey of the Blue Mountains and Hawkesbury Regions

On behalf of the Faculty of Dentistry, University of Sydney, and the Wentworth Area Health Service we are writing about a survey of children's dental health in the Blue Mountains and Hawkesbury regions. Your school has been selected again to participate in this survey to follow up the original one 10 years ago which involved a random sample of schools.

Since then, water fluoridation has been introduced into the Blue Mountains to help prevent tooth decay. The purpose of this follow-up survey is to monitor the changes that have occurred in the oral health of children in Blue Mountains and Hawkesbury regions over the last decade.

The survey, which will be conducted according to World Health Organisation guidelines, has been approved by the Human Ethics Committee of the University of Sydney, the Ethics Committee of Wentworth Area Health Service, and by the Strategic Research Unit of the NSW Dept. of Education.

Please take a few minutes to read the material in the attached pack which is intended for parents of children at your school. The survey relies on the cooperation of the participating schools in two ways: -

1. To distribute a survey pack for each child at the school to parents and receive signed consent forms back in sealed labeled envelopes to maintain confidentiality.
2. To provide a suitable space for the survey for the short time that researchers are at the school. All equipment needed will be provided and meet OHS requirements.

If you have any questions about the survey, please do not hesitate to contact me on Ph 02-9845-7537. One of the researchers will contact you within the next week about this letter to discuss what is involved in more depth.

We look forward to working with you on this study, and acknowledge that before it can proceed your agreement in writing will be required.

Yours sincerely,

Dr Wendell Evans
Associate Professor and Principal Investigator

Graham Jenkins.....
CEO WAHS

Appendix D: Information package for parents



The University of Sydney

**Faculty of Dentistry
College of Health Sciences**

Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology

Westmead Centre for Oral Health
Westmead Hospital
Australia NSW 2145

Tel: +61 2 9845 7537 Fax: +61 2 9845 8306
E-mail: w.evans@dentistry.usyd.edu.au

May 2003

Dear Parent/Guardian,

Child Oral Health Survey of the Blue Mountains and Hawkesbury Regions

Welcome to the survey of children's oral health in the Blue Mountains and Hawkesbury regions. Your child's school is one of those selected to participate. Details of this survey are described in the Information Statement.

The last survey of children's oral health in your region was undertaken 10 years ago and since then water fluoridation has been introduced into the Blue Mountains to help prevent tooth decay. The purpose of this follow-up survey is to monitor the changes that have occurred in the Hawkesbury and Blue Mountains regions since then.

The survey, which will be conducted under my direction according to World Health Organisation guidelines, has been approved by your School Principal, and the Ethics Committees of the NSW Department of Education, University of Sydney, and Wentworth Area Health Service.

Please take a few minutes to read the Information Statement, the enclosed questionnaire, and the consent forms.

I hope that you will consent to the dental health survey and fill out the attached questionnaire. If your child participates in the survey you will receive a report of your child's dental health needs.

If you have any questions about the survey, please do not hesitate to contact me on 02 9845 7537.

Yours sincerely,

Dr Wendell Evans
Associate Professor and Principal Investigator



The University of Sydney

**Faculty of Dentistry
College of Health Sciences**

Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology

Westmead Centre for Oral Health
Westmead Hospital
Australia NSW 2145

Tel: +61 2 9845 7537 Fax: +61 2 9845 8306
E-mail: w.evans@dentistry.usyd.edu.au

INFORMATION STATEMENT TO PARENTS AND GUARDIANS

Child Oral Health Survey of the Blue Mountains and Hawkesbury Regions

An oral health survey of school children will be conducted by dentists from the Dental School at Sydney University. Approval to conduct this survey has been granted by your school principal, the NSW Department of Education, The University of Sydney, and the Wentworth area Health Service. The purpose of the survey is to monitor the oral health of children living in the Blue Mountains and Hawkesbury regions. In 1993, a similar survey was conducted, and this provided valuable information to assist the planning of a more effective health service and research into establishing effective ways of preventing oral diseases for children residing in these areas.

What is involved

With your permission, we will conduct an oral examination of your child at school according to World Health Organisation criteria. This oral examination, using a dental mirror and a non-sharp ball-ended tooth explorer, will identify any treatment need for tooth decay. We will also record tooth cleanliness, the number of fillings and missing teeth (if any). In addition, we will take a photograph of your child's front teeth as a record of tooth colour and shape (the photograph will not include your child's face). This photograph will be stored and used to compare tooth colour in future studies. No x-rays will be taken.

You are also asked to complete the enclosed questionnaire and return it to your child's school in the envelope provided. Finally, you will be advised of any need to arrange for dental care.

Confidentiality

Only the University dentists will have access to the oral examination and questionnaire information. This information will be put in a computer for analysis and the examination and questionnaire forms will be destroyed. Your name and your child's name **will not** be put in the computer.

The survey results will be published and a report will be sent to your school. The report will not include names or other information that could identify you or your child.

Your participation and consent

Your participation will make an important contribution to knowledge about oral health of school children in your region.

We would be grateful if you would read and complete the **QUESTIONNAIRE**. There are two copies of the **CONSENT FORM**. Please complete and sign both of them. Keep the completed **CONSENT FORM** on the back of this **INFORMATION STATEMENT** for your reference, and return the other copy and completed questionnaire to your child's school.

Any person with concerns or complaints about the conduct of a research study can contact the Manager for Ethics Administration, University of Sydney on (02) 9351 4811.



The University of Sydney

Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology

**Faculty of Dentistry
College of Health Sciences**

Westmead Centre for Oral Health
Westmead Hospital
Australia NSW 2145

Tel: +61 2 9845 7537 Fax: +61 2 9845 8306
E-mail: w.evans@dentistry.usyd.edu.au

Child Oral Health Survey of Blue Mountains and Hawkesbury Regions

Dear Parent/Guardian,

Thank you for agreeing to participate in the Blue Mountains and Hawkesbury Child Oral Health Survey. Please fill in the CONSENT below and the QUESTIONNAIRE and CONSENT enclosed. All information you provide will be strictly confidential. Please return the QUESTIONNAIRE and CONSENT to your child's school and keep this copy for your own records.

**CHILD ORAL HEALTH SURVEY
PARENTAL (OR GUARDIAN) CONSENT FORM**

CHILD'S FIRST NAME: **CHILD'S SURNAME:**

DATE of BIRTH / / **SEX: Male Female**
day month year (Circle one)

ADDRESS: **TOWN/SUBURB:**

STATE: **POSTCODE:** **TELEPHONE:** ()
(Area code) (Number)

SCHOOL: **YEAR LEVEL:**

- I (Please PRINT name) agree and permit my child (as documented above) to participate in the dental survey as described in the INFORMATION STATEMENT TO PARENTS on the back of the letter sent to me.
- I acknowledge that I have read this INFORMATION STATEMENT which describes the purpose of the survey and the nature of the dental examination. I understand this and that a photograph of my child's front teeth will be taken but that this will not include his/her face.
- Before signing this CONSENT FORM, I have been given the opportunity to ask any questions and I have received satisfactory answers. My consent is freely given.
- I understand that I can withdraw my child from the survey at any time without prejudice to my of my child's relationship to the University.
- I agree that research results based on the survey information obtained may be published provided that neither my child nor I may be identified.
- I understand that if I have any questions relating to my child's participation in this research, I may contact Dr Wendell Evans on telephone 02 9845 7537 who will be happy to answer them.
- I acknowledge that I have a copy of the INFORMATION STATEMENT TO PARENTS (OR GUARDIANS) and a signed copy of the CONSENT FORM.

Signature of parent or guardian: **Date:**

**PLEASE KEEP THIS COPY OF THE CONSENT FORM FOR YOUR
RECORDS**



The University of Sydney

**Faculty of Dentistry
College of Health Sciences**

Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology

Westmead Centre for Oral Health
Westmead Hospital
Australia NSW 2145

Tel: +61 2 9845 7537 Fax: +61 2 9845 8306
E-mail: w.evans@dentistry.usyd.edu.au

Child Oral Health Survey of Blue Mountains and Hawkesbury regions

Reminder Notice

Dear Parent/Guardian,

A short time ago you should have received a letter, information sheet, and questionnaire as part of an invitation to participate in an important dental survey which will allow a better understanding of how to protect children's teeth against decay.

If you have already returned the consent form and questionnaire, please accept our thanks and ignore this notice. However, if you haven't done so, please fill and return the consent and questionnaire to your child's school today. Your cooperation will assist us to make this a useful one for the children of your region.

If by some chance, you did not receive the information package or it was misplaced, please contact the Research Team on 9845 7537.

Yours sincerely,

Associate Professor Wendell Evans
Principal Investigator

Appendix E: Questionnaire



Wendell Evans, MDS DDSc
Associate Professor
Community Oral Health and Epidemiology

Westmead Centre for Oral Health
Westmead Hospital
Australia NSW 2145

Tel: +61 2 9845 7537 Fax: +61 2 9845 8306
E-mail: w.evans@dentistry.usyd.edu.au

CHILD ORAL HEALTH SURVEY 2003

Dear Parent/Guardian,

Thank you for agreeing to participate in the Blue Mountains and Hawkesbury Child Oral Health Survey. Please fill in the forms below and the questionnaire. All information you provide will be strictly confidential.

CONSENT FORM

CHILD'S FIRST NAME: CHILD'S SURNAME:
ADDRESS: TOWN/SUBURB:
STATE: POSTCODE: TELEPHONE: ()
code) (Number) (Area
SCHOOL: YEAR LEVEL:

I, (please print your name in full), have read the accompanying cover letter and consent to provide information for the Blue Mountains and Hawkesbury Child Oral Health Survey.

In giving my consent I understand that:

- a) I am free to withdraw my consent at any time, and this will not affect dental advice or treatment in the management of my child's health, now or in the future;
- b) The study is for the purpose of research which, although designed to improve the dental health of children in Australia, may not directly benefit my child; and
- c) The confidentiality of information that I provide for the study will be safeguarded.
- d) I understand what my participation includes. It includes filling in one questionnaire and allowing that information from my child's regular dental examination and visits at the School Dental Service clinic to be used for research purposes only. My consent is given freely.
- e) I am aware that I can make a copy of this Consent Form and the attached information letter when completed.

In case we need to contact you in future for research purposes, it would be useful to know of a person **who does not live with you** and can help the researchers contact you. The researchers will contact that person only if you cannot be contacted.

GIVEN NAME: SURNAME:
ADDRESS: SUBURB:
STATE: POSTCODE: TELEPHONE: ()
code) (Number) (Area
Is this person your mother, brother, friend etc.?

CLINIC USE ONLY – All details must be completed

EXAMINATION DATE / / DATE OF BIRTH / / ID C

PLEASE READ THIS BEFORE STARTING THE QUESTIONNAIRE

- All of the questions in the questionnaire that refer to ‘your child’ concern the child named on the Consent Form at the front of this booklet.
- All of your answers are valuable to us, so please complete all questions to the best of your knowledge. If you are uncertain about a question, please ring (02) 9845 7537 for advice.
- Please ignore the small numbers next to boxes; they are for office use only.

EXAMPLES OF QUESTIONS

- Some questions require you to tick only one box. For example:

Has your child ever used mouthrinse?

(Tick one box only)

- ☒1 Yes
- ☐2 No
- ☐3 Don’t know

- Other questions may allow you to give multiple answers. For example:

When does your child usually brush his/her teeth?

(Tick as many boxes as applicable)

- ☒1 Before breakfast
- ☐2 After breakfast
- ☒3 After lunch
- ☒4 After dinner
- ☐5 Immediately before bed
- ☐6 At other times

- There will always be instructions next to the question telling you how many boxes you can tick. These instructions will be written in *italic* writing.
- Some of the questions ask for information about specific time periods of your child’s life as in the following example. For questions like this, please tick one box for each time period as shown below unless indicated otherwise.

The child in this example brushed his/her teeth **less than once a day when he/she started brushing, once a day at age five and once a day now**. This child’s details should be filled in as follows:

EXAMPLE QUESTION	WHEN HE/SHE STARTED BRUSHING	NOW
How often did/does your child brush his/her teeth with toothpaste?	☒1 Less than once a day ☐2 Once a day ☐3 Twice a day ☐4 More than twice a day	☐1 Less than once a day ☒2 Once a day ☐3 Twice a day ☐4 More than twice a day

- Some questions require a written answer, as in these examples:

At what age did your child start taking fluoride tablets?

8

6

Years

Months

OR

What brand of infant formula did you use?

Enfamil

- The questions should take you around 20 minutes to complete. If you need help filling in the questionnaire, please don’t hesitate to give us a call on (02) 9845 7537.

PLEASE START THE QUESTIONNAIRE ON THE FOLLOWING PAGE:

CHILD ORAL HEALTH SURVEY 2003

Dental Practices

1a

Has your child ever brushed his/her teeth with toothpaste (with or without help from an adult)?
(Tick one box only)

☐₁ Yes

☐₂ No → GO TO QUESTION 5

1b

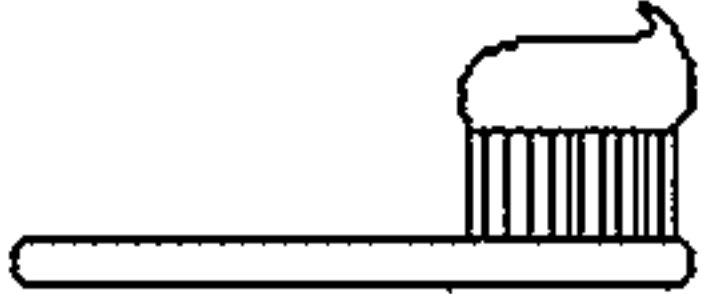
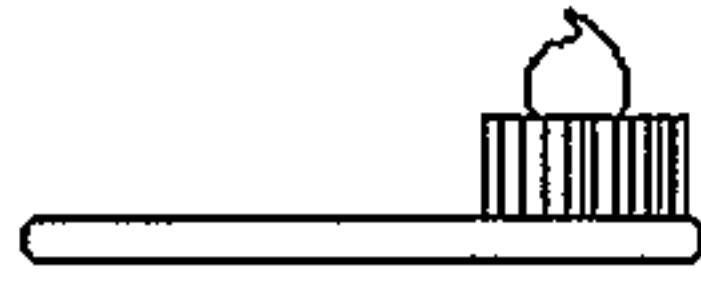
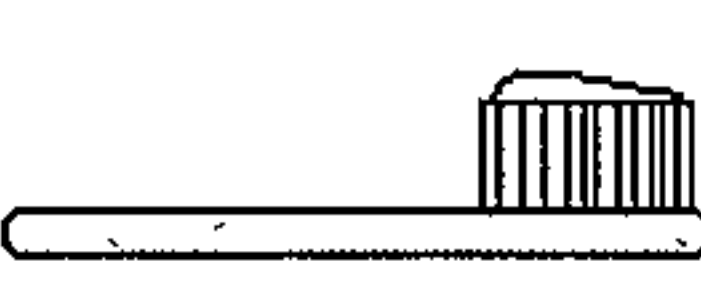
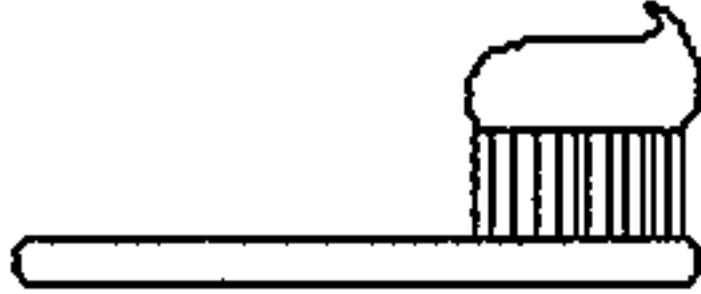
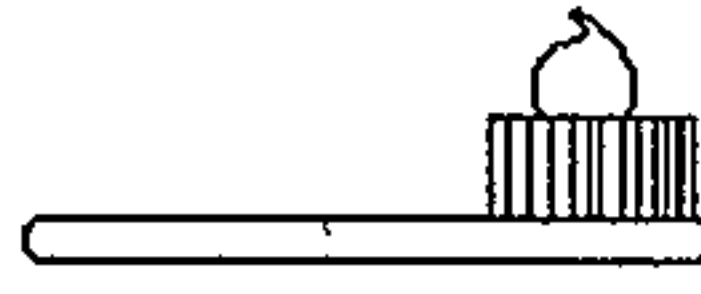
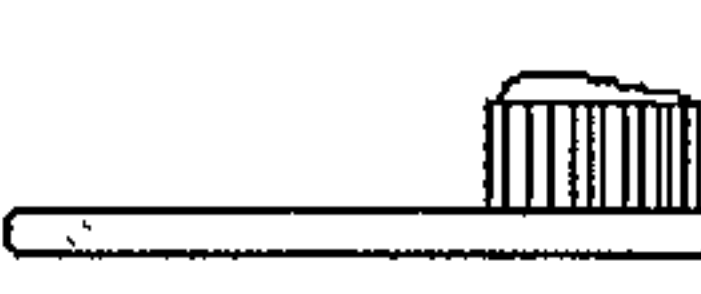
At what age did he/she start brushing with toothpaste (with or without help from an adult)?
(Write age)

.....
Years

.....
Months

2

For the following questions, please tick one box only for each time period in your child's life.

	WHEN YOUR CHILD STARTED BRUSHING	NOW
a) How often did/does your child brush his/her teeth with toothpaste?	☐ ₁ Less than once a day ☐ ₂ Once a day ☐ ₃ Twice a day ☐ ₄ More than twice a day	☐ ₁ Less than once a day ☐ ₂ Once a day ☐ ₃ Twice a day ☐ ₄ More than twice a day
b) What type of toothpaste did/does your child use?	☐ ₁ Standard fluoride toothpaste ☐ ₂ Children's toothpaste ☐ ₃ Non-fluoridated paste ☐ ₄ Don't know/not sure	☐ ₁ Standard fluoride toothpaste ☐ ₂ Children's toothpaste ☐ ₃ Non-fluoridated paste ☐ ₄ Don't know/not sure
c) Have you noticed your child eating or licking toothpaste?	☐ ₁ Often ☐ ₂ Sometimes ☐ ₃ Never	☐ ₁ Often ☐ ₂ Sometimes ☐ ₃ Never
d) What size of toothbrush did/does your child use?	(If your child uses an electric toothbrush, please tick 'Small size')	
	☐ ₁ Small size ☐ ₂ Regular size	☐ ₁ Small size ☐ ₂ Regular size
e) After tooth brushing did/does your child usually...	☐ ₁ just swallow ☐ ₂ rinse and swallow ☐ ₃ rinse and spit ☐ ₄ just spit ☐ ₅ other ☐ ₆ don't know	☐ ₁ just swallow ☐ ₂ rinse and swallow ☐ ₃ rinse and spit ☐ ₄ just spit ☐ ₅ other ☐ ₆ don't know
f) How much toothpaste did/does your child (or do you) use on his/her toothbrush?	☐ ₁  ☐ ₂  ☐ ₃ 	☐ ₁  ☐ ₂  ☐ ₃ 

3

How did/do you assist your child to brush his/her teeth? (Tick one box only for each time period)

WHEN YOUR CHILD STARTED BRUSHING	NOW
☐1 Applied toothpaste & brushed teeth ☐2 Put toothpaste on his/her brush only ☐3 Just watched and gave advice ☐4 Helped him/her in a different way ☐5 Did not help him/her brush	☐1 Applied toothpaste & brushed teeth ☐2 Put toothpaste on his/her brush only ☐3 Just watched and gave advice ☐4 Helped him/her in a different way ☐5 Did not help him/her brush

4

When did/does your child usually brush his/her teeth?
(Tick as many boxes as applicable for each time period)

WHEN YOUR CHILD STARTED BRUSHING	NOW
☐1 Before breakfast ☐2 After breakfast ☐3 After lunch ☐4 After dinner ☐5 Immediately before bed ☐6 At other times	☐1 Before breakfast ☐2 After breakfast ☐3 After lunch ☐4 After dinner ☐5 Immediately before bed ☐6 At other times

5

Has your child ever taken fluoride tablets or drops? (Tick one box only)

☐1 Yes, fluoride tablets only

☐2 Yes, fluoride drops only

☐3 Yes, fluoride tablets and fluoride drops

☐4 No

☐5 Don't know

GO TO QUESTION 11

GO TO QUESTION 11

6

At what age did your child ...

start taking fluoride tablets or drops?
(Write age or '0' if used since birth)

.....
Years

.....
Months

stop taking fluoride tablets or drops?
(Write age or 'still taking')

.....
Years

.....
Months

7

How many fluoride tablets or drops did/does your child take at a time?
e.g. ½ tablet, 2 drops.
(Write number of tablets or drops or '0' if not taken at this age)

BIRTH – 6 MONTHS	6 MONTHS – 4 YEARS	OVER 4 YEARS
..... tablet/s	 tablet/s	 tablet/s
..... drop/s	 drop/s	 drop/s

8

How often did /does your child take the number of tablets or drops you wrote in Question 7?
(Tick one box only for each age group)

BIRTH – 6 MONTHS	6 MONTHS – 4 YEARS	OVER 4 YEARS
☐1 More than once a day ☐2 Once a day ☐3 5 to 6 times a week ☐4 2 to 4 times a week ☐5 Once a week ☐6 Infrequently/varied ☐7 Did not take at this age	☐1 More than once a day ☐2 Once a day ☐3 5 to 6 times a week ☐4 2 to 4 times a week ☐5 Once a week ☐6 Infrequently/varied ☐7 Did not take at this age	☐1 More than once a day ☐2 Once a day ☐3 5 to 6 times a week ☐4 2 to 4 times a week ☐5 Once a week ☐6 Infrequently/varied ☐7 Did not take at this age

9	What time of day did/does your child usually take fluoride tablets or drops? (Tick as many boxes as applicable)	BIRTH – 6 MONTHS	6 MONTHS – 4 YEARS	OVER 4 YEARS
		☐ ₁ Before breakfast ☐ ₂ After breakfast ☐ ₃ After lunch ☐ ₄ After dinner ☐ ₅ In the hour before bed ☐ ₆ At other times	☐ ₁ Before breakfast ☐ ₂ After breakfast ☐ ₃ After lunch ☐ ₄ After dinner ☐ ₅ In the hour before bed ☐ ₆ At other times	☐ ₁ Before breakfast ☐ ₂ After breakfast ☐ ₃ After lunch ☐ ₄ After dinner ☐ ₅ In the hour before bed ☐ ₆ At other times

10	How did/does your child usually take fluoride tablets or drops? (Tick as many boxes as applicable)
	☐ ₁ Swallowing ☐ ₂ Chewing and swallowing ☐ ₃ Dissolved in a glass of water ☐ ₄ Dissolved in a litre of water ☐ ₅ Taken in another way

11	Has your child ever used <u>fluoride</u> mouthrinse? (Tick one box only)
	Please note that not all mouthrinses contain fluoride. If possible, check the ingredients on the bottle. ☐ ₁ Yes ☐ ₂ No → GO TO QUESTION 14 ☐ ₃ Don't know → GO TO QUESTION 14

12	At what age did your child ...					
	<table><tr><td>start using fluoride mouthrinse? (Write age or '0' if used since birth)</td><td>..... Years</td><td>..... Months</td></tr><tr><td>stop using fluoride mouthrinse? (Write age or 'still taking')</td><td>..... Years</td><td>..... Months</td></tr></table>	start using fluoride mouthrinse? (Write age or '0' if used since birth)	 Years	 Months	stop using fluoride mouthrinse? (Write age or 'still taking')	 Years
start using fluoride mouthrinse? (Write age or '0' if used since birth)	 Years	 Months				
stop using fluoride mouthrinse? (Write age or 'still taking')	 Years	 Months				

13	How often did/does your child use fluoride mouthrinse at the following times? (Tick one box only for each time period)			
	<table><tr><th>When he/she started using it</th><th>Now or when he/she stopped using it</th></tr><tr><td>☐₁ Every day ☐₂ A few times a week ☐₃ Once a week ☐₄ Infrequently</td><td>☐₁ Every day ☐₂ A few times a week ☐₃ Once a week ☐₄ Infrequently</td></tr></table>	When he/she started using it	Now or when he/she stopped using it	☐ ₁ Every day ☐ ₂ A few times a week ☐ ₃ Once a week ☐ ₄ Infrequently
When he/she started using it	Now or when he/she stopped using it			
☐ ₁ Every day ☐ ₂ A few times a week ☐ ₃ Once a week ☐ ₄ Infrequently	☐ ₁ Every day ☐ ₂ A few times a week ☐ ₃ Once a week ☐ ₄ Infrequently			

14	Has your child ever had fluoride gel applied to his/her teeth? (Tick one box only in each column)					
	<table><tr><th>School Dental Service</th><th>Private dental practice</th><th>Home application</th></tr><tr><td>☐₁ Yes (write number of times) → times ☐₂ No ☐₃ Don't know</td><td>☐₁ Yes (write number of times) → times ☐₂ No ☐₃ Don't know</td><td>☐₁ Yes (write number of times) → times ☐₂ No ☐₃ Don't know</td></tr></table>	School Dental Service	Private dental practice	Home application	☐ ₁ Yes (write number of times) → times ☐ ₂ No ☐ ₃ Don't know	☐ ₁ Yes (write number of times) → times ☐ ₂ No ☐ ₃ Don't know
School Dental Service	Private dental practice	Home application				
☐ ₁ Yes (write number of times) → times ☐ ₂ No ☐ ₃ Don't know	☐ ₁ Yes (write number of times) → times ☐ ₂ No ☐ ₃ Don't know	☐ ₁ Yes (write number of times) → times ☐ ₂ No ☐ ₃ Don't know				

Birth Place & Residential Movements

15

Please read the example below and then complete the table on the next page.

Write the name of each suburb, town or location your child has lived in, and the years that he/she lived there. You are able to list one residence more than once if your usual source of water has changed over time. Only include places where your child has lived for six months or more.

Then tick a box to indicate your child’s usual source of drinking water at home and at school, and the water used in cooking food for your child.

PLEASE NOTE:

We refer to two different types of filtered water in the table below: carbon/charcoal and osmosis/distillation.

Carbon/charcoal filtered: Refers to carbon or charcoal filters (e.g. ‘Pura Tap’, ‘Aqua Pure’)

Osmosis/distillation filtered: Refers to reverse osmosis or distillation systems

EXAMPLE:

- This is an example of a child who has lived at their current address in Unley, SA since 1995 where she has used unfiltered tap water at home and for cooking. At school she drank spring water.
- Prior to that she lived for two months in Mount Barker. As she lived there for less than six months it is not included in the table.
- Prior to that she lived for nine months in Gawler where she used filtered tap water from a bench top charcoal filter (Carbon/charcoal filtered) at home and tank water for cooking.
- This child only lived in Gawler for part of a year, so the same year has been written in the “From” and “To” boxes.
- Her details would be filled in as follows:

Suburb, town or location (Start at current residence of 6 months or more)	Country/ Australian State or Territory	Years of residence		(Please tick one box only below in each column where applicable)			
		From	To	What was your child’s usual source of water?	At home	At school	For cooking
1. Unley	SA	1995	2002	Tap/mains 1	✓		✓
				Carbon/charcoal filtered			
				Osmosis/distillation filtered 3			
				Tank			
				Spring/mineral 5		✓	
				Bore			
				Don’t know 7			
2. Gawler	SA	1994	1994	Tap/mains 1			
				Carbon/charcoal filtered	✓		
				Osmosis/distillation filtered 3			
				Tank			✓
				Spring/mineral 5			
				Bore			
				Don’t know 7			

If you have any trouble filling this table in, please don’t hesitate to give us a call on the Child Oral Health Study Hotline: 1800-333-370. We would be more than happy to help you fill it in!

We have given you enough spaces for six residences/entries. If you run out of spaces please attach an extra sheet of paper following the same format as in our table.

You are able to list one residence more than once if your usual source of water has changed over time.

Suburb, town or location (Start at current residence of 6 months or more)	Country/ Australian State or Territory	Years of residence		(Please tick one box only below in each column where applicable)			
		From	To	What was your child's usual source of water?	At home	At school	For cooking
1.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			
2.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			
3.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			
4.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			
5.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			
6.				Tap/mains 1			
				Filtered 2			
				Tank 3			
				Bottled 4			
				Bore 5			
				Don't know 6			

Dietary Intake

16

At each residence you listed on the previous page, how much of the total amount of fluids drunk was tap/mains water?

Please complete the table below. (Tick one box only for each residence/ entry you stated on the previous page)

In our example below more than half of what this child drank was tap water.

	Almost none ₁	Less than half ₂	About half ₃	More than half ₄	Almost all ₅
EXAMPLE→				✓	
Residence/ entry 1 on previous page					
Residence/ entry 2 on previous page					
Residence/ entry 3 on previous page					
Residence/ entry 4 on previous page					
Residence/ entry 5 on previous page					
Residence/ entry 6 on previous page					

17

Was your child ever fed infant formula? (Tick one box only)

- ☐₁ Yes
- ☐₂ No → GO TO QUESTION 22
- ☐₃ Don't know → GO TO QUESTION 22

18

What did you usually add to the infant formula for your child? (Tick one box only)

- ☐₁ Tap water – mains supply
- ☐₂ Carbon/charcoal filtered tap water
- ☐₃ Osmosis/distillation filtered tap water
- ☐₄ Mineral/Spring water
- ☐₅ Tank water
- ☐₆ Unknown

In the table below, please write the number of serves of food your child eats in a usual day, AND how many serves he/she usually eats in the last hour before bed. Please use the standard serves as listed below.

EXAMPLE: In our example below this child eats 3 serves of fruit in a usual day, with 1 of these 3 serves of fruit eaten in the last hour before the child goes to bed.

Enter the number of serves your child eats of each food or '0' if he/she does not usually eat the food.		
	In a usual..... ↓ day (total)↓	How many of those eaten in a usual day are eaten in the last ↓ hour before bed ↓
EXAMPLE FOR FRUIT →	3	1
Fruit e.g., apples, oranges	.....	.....
Pure fruit juices and fruit drinks, e.g., orange, apple	.....	.....
Sweetened cordial drinks e.g., packet or bottled	.....	.....
Fizzy drinks/sports drinks e.g., Lemonade, Gatorade	.....	.....
Cola drinks e.g., Coke, Pepsi	.....	.....
Plain Milk	.....	.....
Sweetened dairy products e.g., yoghurt	.....	.....
Chocolate and sugary lollies	.....	.....
Muesli bars and health bars	.....	.....
Dried fruits e.g., Roll-ups, dried apricots	.....	.....

General Information

20

Was your child born prematurely? (i.e. before 37 weeks) (Tick one box only)

- ☐1 Yes
- ☐2 No
- ☐3 Don't know

21

What was the birth weight of your child? (Tick one box only and write weight in spaces provided)

- ☐1 ____ Kilograms (e.g. 3.2 kg) OR ____ pounds ____ ounces
- ☐2 Don't know

Characteristics of the Household

The following questions are about your household. These questions will help to decide if different methods of preventing dental problems work equally well for all groups within the community and to ensure that the researchers obtain an accurate cross-section of households.

22

In which country was your child born?

(Write name of country)

OFFICE USE ONLY

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23

In which country was mother born?

(Write name of country)

OFFICE USE ONLY

--	--	--

24

Is English the main laguage spoken at home?

- ☐1 Yes
- ☐2 No

25

Is your child of Aboriginal or Torres Strait Islander origin? (Tick one box only)

- ☐1 No
- ☐2 Yes, Aboriginal
- ☐3 Yes, Torres Strait Islander
- ☐4 Yes, Aboriginal and Torres Strait Islander

26

Does your child live in a one-parent household? (Tick one box only)

- ☐1 Yes
- ☐2 No

27

Please complete the table below.
If your child lives in a one-parent household, please fill in one column for yourself. If he/she lives in a two-parent household, please fill in both columns for yourself and your partner.

QUESTION	↓ Parent or Guardian (A)	↓ Parent or Guardian (B)
a) What is <u>your</u> age?	 Years	 Years
b) What is your sex?	☐ ₁ Male ☐ ₂ Female	☐ ₁ Male ☐ ₂ Female
c) In which country were you born? (Write country)	.....	.....
d) Are you of Aboriginal or Torres Strait Islander origin? (Tick one box only)	☐ ₁ No ☐ ₂ Yes, Aboriginal ☐ ₃ Yes, Torres Strait Islander ☐ ₄ Yes, Aboriginal & Torres Strait Islander	☐ ₁ No ☐ ₂ Yes, Aboriginal ☐ ₃ Yes, Torres Strait Islander ☐ ₄ Yes, Aboriginal & Torres Strait Islander
e) What is the highest level of education you have? (Tick one box only)	☐ ₁ Some high school ☐ ₂ Completed high school ☐ ₃ Some vocational training (i.e. trade) ☐ ₄ Completed vocational training ☐ ₅ Some University or College ☐ ₆ Completed University or College	☐ ₁ Some high school ☐ ₂ Completed high school ☐ ₃ Some vocational training (i.e. trade) ☐ ₄ Completed vocational training ☐ ₅ Some University or College ☐ ₆ Completed University or College
f) What is your usual occupation? (Write description, e.g. Accounts clerk)	.....	.....
g) Please write a brief description of your usual type of work, (e.g. in charge of invoicing, supervisor in a large firm, mowing lawns)	..... .....	..... .....
h) Do you currently have full time or part time work of any kind? (Tick one box only)	☐ ₁ Yes, full-time ☐ ₂ Yes, part-time ☐ ₃ No, not currently working	☐ ₁ Yes, full-time ☐ ₂ Yes, part-time ☐ ₃ No, not currently working
i) How many teeth have you had pulled out due to tooth decay?	(Write number)	(Write number)
j) How many fillings do you have in your mouth?	(Write number)	(Write number)

28

Which category does your total household income (before tax) fall into? Include any salaries, pensions, allowances, benefits, etc from all persons in the household.
(Tick one box only)

Household income per year
☐₁ Up to \$20,000
☐₂ \$20,001 to \$40,000
☐₃ \$40,001 to \$60,000
☐₄ \$60,001 to \$80,000
☐₅ \$80,000 to \$100,000
☐₆ Over \$100,000

OFFICE USE ONLY

C1			
C2			
F1			
F2			

29

How many people are dependent on this total household income, including yourself?

(Write number) Adults Children

30

Do you have private dental insurance ? Yes ☐₁ No ☐₂

31

How long is it since your child had a dental visit?
(Tick one box only)

- ☐₁ Less than 6 months
- ☐₂ Between 6 and 12 months
- ☐₃ Between 1 and 2 years
- ☐₄ More than 2 years ago
- ☐₅ Never
- ☐₆ Don't know

32

Where did your child go for the last dental visit?
(Tick one box only)

- ☐₁ Private Dentist
- ☐₂ Public Hospital Dental Clinic
- ☐₃ Public Child Dental Clinic
- ☐₄ Never had dental care

33

Why did you last seek dental treatment for your child?
(Tick one box only)

- ☐₁ Pain relief
- ☐₂ Check-up
- ☐₃ Filling
- ☐₄ Crooked teeth
- ☐₅ Other
- ☐₆ Never had care

C					
---	--	--	--	--	--

34

The following questions are general statements regarding the dental health of your child.
The answers are on a five-point scale, where 1 means 'Definitely yes' and 5 'Definitely no'.
(Circle one number for each row)

Please answer the following statements and circle one number	Definitely Yes	Definitely No
a) My child practises acceptable home dental behaviour.	1 ----- 2 ----- 3 ----- 4 ----- 5	
b) My child receives adequate dental care.	1 ----- 2 ----- 3 ----- 4 ----- 5	
c) My child needs dental care, but I put it off.	1 ----- 2 ----- 3 ----- 4 ----- 5	
d) My child needs dental care, but he/she puts it off.	1 ----- 2 ----- 3 ----- 4 ----- 5	
e) My child brushes his/her teeth well.	1 ----- 2 ----- 3 ----- 4 ----- 5	
f) My child controls between-meal snacking well.	1 ----- 2 ----- 3 ----- 4 ----- 5	
g) My child considers his/her dental health to be important.	1 ----- 2 ----- 3 ----- 4 ----- 5	

Your Comments

Thank you. Your contribution to this study is greatly appreciated. Please take a moment to check that you have answered each question, have signed the consent form, and filled in the label on the front of the envelope provided. Then place the completed questionnaire and consent form inside the envelope, seal it, and return it to your child's school.

If you have any comments, please feel free to write them in the space below.

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting or typing. There are no margins, text, or other markings on the page.

Thank you for your support!

Appendix F: ABS classification of occupation

Australian Bureau of Statistics

Occupation classification: Major And Sub-Major Groups

- 1 Managers And Administrators
 - 11 Generalist Managers
 - 12 Specialist Managers
 - 13 Farmers and Farm Managers

- 2 Professionals
 - 21 Science, Building and Engineering Professionals
 - 22 Business and Information Professionals
 - 23 Health Professionals
 - 24 Education Professionals
 - 25 Social, Arts and Miscellaneous Professionals

- 3 Associate Professionals
 - 31 Science, Engineering and Related Associate Professionals
 - 32 Business and Administration Associate Professionals
 - 33 Managing Supervisors (Sales and Service)
 - 34 Health and Welfare Associate Professionals
 - 39 Other Associate Professionals

- 4 Tradespersons And Related Workers
 - 41 Mechanical and Fabrication Engineering Tradespersons
 - 42 Automotive Tradespersons
 - 43 Electrical and Electronics Tradespersons
 - 44 Construction Tradespersons
 - 45 Food Tradespersons
 - 46 Skilled Agricultural and Horticultural Workers
 - 49 Other Tradespersons and Related Workers

- 5 Advanced Clerical And Service Workers
 - 51 Secretaries and Personal Assistants
 - 59 Other Advanced Clerical and Service Workers

- 6 Intermediate Clerical, Sales And Service Workers
 - 61 Intermediate Clerical Workers
 - 62 Intermediate Sales and Related Workers
 - 63 Intermediate Service Workers

- 7 Intermediate Production And Transport Workers
 - 71 Intermediate Plant Operators
 - 72 Intermediate Machine Operators
 - 73 Road and Rail Transport Drivers
 - 79 Other Intermediate Production and Transport Workers

- 8 Elementary Clerical, Sales And Service Workers
 - 81 Elementary Clerks
 - 82 Elementary Sales Workers
 - 83 Elementary Service Workers

- 9 Labourers And Related Workers
 - 91 Cleaners
 - 92 Factory Labourers
 - 99 Other Labourers and Related Workers

Appendix G: Bivariate analyses tables

TABLE F1

Independent variable AGE
The age (in years) of the child at examination.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00530	0.00530	0.01	0.9404
Error	1350	1280.86970	0.94879		
Corrected Total	1351	1280.87500			
	Root MSE	0.97406	R-Square	0.0000	
	Dependent Mean	1.22115	Adj R-Sq	-0.0007	
	Coeff Var	79.76552			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.23312	0.16226	7.60	<.0001
AGE	1	-0.00125	0.01668	-0.07	0.9404

TABLE F2

Independent variable SEX
The sex of the child.
SEX values: 1 = male, 2 = female.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by SEX

FLU		SEX		
Frequency		F	M	Total
Col	Pct			
0		174 25.22	186 28.10	360
1		231 33.48	232 35.05	463
2		232 33.62	194 29.31	426
3		43 6.23	40 6.04	83
4		5 0.72	8 1.21	13
5		5 0.72	2 0.30	7
Total		690	662	1352

Comparisons
Across all categories

Statistics for Table of FLU by SEX

Fisher's Exact Test

Table Probability (P)	1.190E-06
Pr <= P	0.3882

TABLE F3

Independent variable GRADE
The year level of the child.
GRADE values: K= kindergarten, 1 = year level one, 2 = year level two, 3 = year level three, 4 = year level four, 5 = year level five, 6 = year level six.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by GRADE

FLU	GRADE							Total
Frequency Col Pct	K	1	2	3	4	5	6	
0	2 33.33	13 17.57	62 25.83	67 25.87	85 29.31	66 26.51	65 27.78	360
1	2 33.33	29 39.19	77 32.08	107 41.31	98 33.79	79 31.73	71 30.34	463
2	2 33.33	25 33.78	76 31.67	70 27.03	90 31.03	88 35.34	75 32.05	426
3	0 0.00	6 8.11	19 7.92	13 5.02	12 4.14	14 5.62	19 8.12	83
4	0 0.00	1 1.35	4 1.67	2 0.77	2 0.69	2 0.80	2 0.85	13
5	0 0.00	0 0.00	2 0.83	0 0.00	3 1.03	0 0.00	2 0.85	7
Total	6	74	240	259	290	249	234	1352

Comparisons
No comparisons were made

TABLE F4

Independent variable SCHOOL
The Sydney region where the school is located.
SCHOOL values: 1 = Blue Mountains, 2 = Hawkesbury.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by SCHOOL

FLU		SCHOOL	
Frequency			
Col	Pct	B	H
0		113	247
		19.55	31.91
1		239	224
		41.35	28.94
2		181	245
		31.31	31.65
3		33	50
		5.71	6.46
4		8	5
		1.38	0.65
5		4	3
		0.69	0.39
Total		578	774
			1352

Comparisons
Across all categories

Statistics for Table of FLU by SCHOOL

Fisher's Exact Test	
Table Probability (P)	1.557E-13
Pr <= P	2.945E-07

TABLE F5

Independent variable TBEVER
Has your child ever brushed his/her teeth with toothpaste (with or without help from an adult)?
TBEVER values: 1 = yes, 2 = no.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TBEVER					
FLU	TBEVER				
Frequency					
Col Pct	0	1	2	Total	
0	2 13.33	357 26.74	1 50.00	360	
1	2 13.33	460 34.46	1 50.00	463	
2	7 46.67	419 31.39	0 0.00	426	
3	4 26.67	79 5.92	0 0.00	83	
4	0 0.00	13 0.97	0 0.00	13	
5	0 0.00	7 0.52	0 0.00	7	
Total	15	1335	2	1352	

Comparisons
Across categories (0) and (1)

Statistics for Table of FLU by TBEVER

Fisher's Exact Test	
Table Probability (P)	9.480E-05
Pr <= P	0.0301

TABLE F6

Independent variable TBAGE
At what age did your child start brushing with toothpaste (with or without help from an adult)?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.92973	1.92973	2.06	0.1513
Error	1254	1173.85371	0.93609		
Corrected Total	1255	1175.78344			
Root MSE		0.96752	R-Square	0.0016	
Dependent Mean		1.22611	Adj R-Sq	0.0008	
Coeff Var		78.90911			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.28934	0.05181	24.89	<.0001
TBAGE	1	-0.03032	0.02112	-1.44	0.1513

TABLE F7

Independent variable TPTIMES1
How often did/does your child brush his/her teeth with toothpaste when your child started brushing?
TPTIMES1 values: 1 = less than once a day, 2 = once a day, 3 = twice a day, 4 = more than twice a day.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPTIMES1

FLU	TPTIMES1					
Frequency						
Col Pct	0	1	2	3	4	Total
0	10 21.74	52 33.77	159 25.65	134 25.97	5 31.25	360
1	14 30.43	53 34.42	204 32.90	185 35.85	7 43.75	463
2	15 32.61	42 27.27	214 34.52	152 29.46	3 18.75	426
3	7 15.22	7 4.55	31 5.00	37 7.17	1 6.25	83
4	0 0.00	0 0.00	8 1.29	5 0.97	0 0.00	13
5	0 0.00	0 0.00	4 0.65	3 0.58	0 0.00	7
Total	46	154	620	516	16	1352

Comparisons
Across categories (1) (2) (3) (4)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPTIMES1

Statistic	DF	Value	Prob
Chi-Square	9	11.7912	0.2253

TABLE F8

Independent variable TPTIMES2
How often did/does your child brush his/her teeth with toothpaste now?
TPTIMES2 values: 1 = less than once a day, 2 = once a day, 3 = twice a day,
4 = more than twice a day.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by TPTIMES2

FLU		TPTIMES2				
Frequency						
Col Pct	0	1	2	3	4	Total
0	10 21.28	18 23.68	122 28.11	207 26.44	3 25.00	360
1	17 36.17	25 32.89	153 35.25	261 33.33	7 58.33	463
2	14 29.79	30 39.47	128 29.49	252 32.18	2 16.67	426
3	6 12.77	2 2.63	25 5.76	50 6.39	0 0.00	83
4	0 0.00	1 1.32	5 1.15	7 0.89	0 0.00	13
5	0 0.00	0 0.00	1 0.23	6 0.77	0 0.00	7
Total	47	76	434	783	12	1352

Comparisons
Across categories (1) (2) (3,4)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPTIMES2

Statistic	DF	Value	Prob
Chi-Square	6	4.5140	0.6075

TABLE F9

Independent variable TPTYPE1
What type of toothpaste did your child use when your child started brushing?
TPTYPE1 values: 1 = standard fluoride toothpaste, 2 = children's toothpaste, 3 = non-fluoridated toothpaste, 4 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPTYPE1

FLU		TPTYPE1				
Frequency						
Col Pct	0	1	2	3	4	Total
0	10 21.28	87 28.90	255 26.13	4 23.53	4 36.36	360
1	17 36.17	99 32.89	338 34.63	6 35.29	3 27.27	463
2	13 27.66	92 30.56	311 31.86	7 41.18	3 27.27	426
3	7 14.89	17 5.65	59 6.05	0 0.00	0 0.00	83
4	0 0.00	5 1.66	8 0.82	0 0.00	0 0.00	13
5	0 0.00	1 0.33	5 0.51	0 0.00	1 9.09	7
Total	47	301	976	17	11	1352

Comparisons
Across categories (1) (2) (3,4)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPTYPE1

Statistic	DF	Value	Prob
Chi-Square	6	1.7840	0.9385

TABLE F10

Independent variable TPTYPE2
What type of toothpaste did your child use now?
TPTYPE2 values: 1 = standard fluoride toothpaste, 2 = children's toothpaste, 3 = non-fluoridated toothpaste, 4 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPTYPE2

FLU	TPTYPE2					
Frequency						
Col Pct	0	1	2	3	4	Total
0	13 23.64	274 27.87	67 23.18	4 20.00	2 40.00	360
1	18 32.73	327 33.27	107 37.02	11 55.00	0 0.00	463
2	17 30.91	309 31.43	92 31.83	5 25.00	3 60.00	426
3	7 12.73	56 5.70	20 6.92	0 0.00	0 0.00	83
4	0 0.00	11 1.12	2 0.69	0 0.00	0 0.00	13
5	0 0.00	6 0.61	1 0.35	0 0.00	0 0.00	7
Total	55	983	289	20	5	1352

Comparisons
Across categories (1) (2) (3,4)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPTYPE2

Statistic	DF	Value	Prob
Chi-Square	6	5.5114	0.4801

TABLE F11

Independent variable TPLICK1
Have you noticed your child eating or licking toothpaste when your child started brushing?
TPLICK1 values: 1 = often, 2 = sometimes, 3 = never.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPLICK1

FLU		TPLICK1				Total
Frequency	Col Pct	0	1	2	3	
0		10 20.83	20 19.61	135 26.63	195 28.06	360
1		16 33.33	29 28.43	183 36.09	235 33.81	463
2		14 29.17	44 43.14	149 29.39	219 31.51	426
3		8 16.67	7 6.86	31 6.11	37 5.32	83
4		0 0.00	0 0.00	7 1.38	6 0.86	13
5		0 0.00	2 1.96	2 0.39	3 0.43	7
Total		48	102	507	695	1352

Comparisons
Across categories (1) (2) (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPLICK1

Statistic	DF	Value	Prob
Chi-Square	6	10.0222	0.1237

TABLE F12

Independent variable TPLICK2
Have you noticed your child eating or licking toothpaste now?
TPLICK2 values: 1 = often, 2 = sometimes, 3 = never.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by TPLICK2

FLU		TPLICK2				Total
Frequency						
Col Pct	0	1	2	3		
0	10 20.00	5 38.46	54 24.22	291 27.30		360
1	18 36.00	3 23.08	79 35.43	363 34.05		463
2	16 32.00	3 23.08	70 31.39	337 31.61		426
3	6 12.00	2 15.38	14 6.28	61 5.72		83
4	0 0.00	0 0.00	3 1.35	10 0.94		13
5	0 0.00	0 0.00	3 1.35	4 0.38		7
Total	50	13	223	1066		1352

Comparisons
Across categories (1,2) and (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPLICK2

Statistic	DF	Value	Prob
Chi-Square	3	1.7911	0.6169

TABLE F13

Independent variable TBSIZE1
What size of toothbrush did/does your child use when your child started brushing?
TBSIZE1 values: 1 = small size, 2 = regular size.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TBSIZE1

FLU		TBSIZE1			Total
Frequency	Col Pct	0	1	2	
0		12 24.00	327 26.91	21 24.14	360
1		17 34.00	411 33.83	35 40.23	463
2		14 28.00	387 31.85	25 28.74	426
3		7 14.00	72 5.93	4 4.60	83
4		0 0.00	12 0.99	1 1.15	13
5		0 0.00	6 0.49	1 1.15	7
Total		50	1215	87	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by TBSIZE1

Fisher's Exact Test	
Table Probability (P)	1.176E-04
Pr <= P	0.6062

TABLE F14

Independent variable TBSIZE2
What size of toothbrush did/does your child use now?
TBSIZE2 values: 1 = small size, 2 = regular size.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by TBSIZE2

FLU		TBSIZE2			Total
Frequency	Col Pct	0	1	2	
0		12 23.08	159 28.49	189 25.47	360
1		20 38.46	189 33.87	254 34.23	463
2		14 26.92	173 31.00	239 32.21	426
3		6 11.54	29 5.20	48 6.47	83
4		0 0.00	7 1.25	6 0.81	13
5		0 0.00	1 0.18	6 0.81	7
Total		52	558	742	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by TBSIZE2

Fisher's Exact Test	
Table Probability (P)	1.567E-06
Pr <= P	0.4243

TABLE F15

Independent variable TBSPIT1
After tooth brushing did/does your child usually do when your child started brushing?
TBSPIT1 values: 1 = just swallow, 2 = rinse and swallow, 3 = rinse and spit, 4 = just spit, 5 = other, 6 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TBSPIT1

FLU		TBSPIT1							Total
Frequency	Col Pct	0	1	2	3	4	5	6	
0		10 21.28	43 25.00	31 22.14	204 26.53	57 31.84	2 50.00	13 31.71	360
1		16 34.04	57 33.14	49 35.00	273 35.50	56 31.28	1 25.00	11 26.83	463
2		14 29.79	59 34.30	50 35.71	237 30.82	51 28.49	1 25.00	14 34.15	426
3		7 14.89	9 5.23	7 5.00	44 5.72	14 7.82	0 0.00	2 4.88	83
4		0 0.00	3 1.74	2 1.43	6 0.78	1 0.56	0 0.00	1 2.44	13
5		0 0.00	1 0.58	1 0.71	5 0.65	0 0.00	0 0.00	0 0.00	7
Total		47	172	140	769	179	4	41	1352

Comparisons
Across categories (1) (2) (3) (4,5,6)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TBSPIT1

Statistic	DF	Value	Prob
Chi-Square	9	6.9948	0.6377

TABLE F16

Independent variable TBSPIT2
After tooth brushing did/does your child usually do when now?
TBSPIT2 values: 1 = just swallow, 2 = rinse and swallow, 3 = rinse and spit,
4 = just spit, 5 = other, 6 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by TBSPIT2

FLU		TBSPIT2							Total
Frequency	Col Pct	0	1	2	3	4	5	6	
0		10 19.61	1 5.26	7 15.22	305 27.02	34 33.33	1 100.00	2 50.00	360
1		19 37.25	5 26.32	15 32.61	394 34.90	30 29.41	0 0.00	0 0.00	463
2		15 29.41	11 57.89	20 43.48	349 30.91	29 28.43	0 0.00	2 50.00	426
3		7 13.73	1 5.26	2 4.35	65 5.76	8 7.84	0 0.00	0 0.00	83
4		0 0.00	0 0.00	1 2.17	11 0.97	1 0.98	0 0.00	0 0.00	13
5		0 0.00	1 5.26	1 2.17	5 0.44	0 0.00	0 0.00	0 0.00	7
Total		51	19	46	1129	102	1	4	1352

Comparisons
Across categories (1) (2) (3,4,5,6)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TBSPIT2

Statistic	DF	Value	Prob
Chi-Square	3	11.5759	0.0090

TABLE F17

Independent variable TPP1
How much toothpaste did/does your child (or do you) use on his/her toothbrush when your child started brushing?
TPP1 values: 1 = large amount, 2 = pea sized, 3 = small amount.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPP1

FLU		TPP1				Total
Frequency	Col Pct	0	1	2	3	
0		11 22.00	30 27.03	110 25.82	209 27.32	360
1		19 38.00	33 29.73	152 35.68	259 33.86	463
2		13 26.00	37 33.33	134 31.46	242 31.63	426
3		7 14.00	7 6.31	23 5.40	46 6.01	83
4		0 0.00	1 0.90	5 1.17	7 0.92	13
5		0 0.00	3 2.70	2 0.47	2 0.26	7
Total		50	111	426	765	1352

Comparisons
Across categories (1) (2) (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPP1

Statistic	DF	Value	Prob
Chi-Square	6	2.3479	0.8851

TABLE F18

Independent variable TPP2

How much toothpaste did/does your child (or do you) use on his/her toothbrush now?

TPP2 values: 1 = large amount, 2 = pea sized, 3 = small amount.

Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TPP2

FLU		TPP2				Total
Frequency						
Col	Pct	0	1	2	3	
0		12 22.64	121 27.88	175 25.77	52 27.96	360
1		19 35.85	134 30.88	241 35.49	69 37.10	463
2		16 30.19	152 35.02	204 30.04	54 29.03	426
3		6 11.32	20 4.61	48 7.07	9 4.84	83
4		0 0.00	5 1.15	6 0.88	2 1.08	13
5		0 0.00	2 0.46	5 0.74	0 0.00	7
Total		53	434	679	186	1352

Comparisons

Across categories (1) (2) (3)

Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by TPP2

Statistic	DF	Value	Prob
Chi-Square	6	8.1223	0.2293

TABLE F19

Independent variable FTAB

Has your child ever taken fluoride tablets or drops?
FTAB values: 1 = fluoride tablets only, 2 = fluoride drops only,
3 = fluoride tablets and drops, 4 = no fluoride tablets or drops,
5 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by FTAB

FLU	FTAB						
Frequency	0	1	2	3	4	5	Total
Col Pct							
0	2 10.00	10 17.86	13 35.14	2 18.18	332 27.10	1 33.33	360
1	7 35.00	18 32.14	10 27.03	5 45.45	421 34.37	2 66.67	463
2	7 35.00	27 48.21	12 32.43	3 27.27	377 30.78	0 0.00	426
3	4 20.00	1 1.79	2 5.41	1 9.09	75 6.12	0 0.00	83
4	0 0.00	0 0.00	0 0.00	0 0.00	13 1.06	0 0.00	13
5	0 0.00	0 0.00	0 0.00	0 0.00	7 0.57	0 0.00	7
Total	20	56	37	11	1225	3	1352

Comparisons

Across categories (1,2,3) and (4)

Statistics for Table of FLU by FTAB

Fisher's Exact Test

Table Probability (P)	4.802E-05
Pr <= P	0.4718

TABLE F20

Independent variable T1AGE
At what age did your child start taking fluoride tablets or drops?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.12221	0.12221	0.16	0.6892
Error	82	62.19922	0.75853		
Corrected Total	83	62.32143			
Root MSE		0.87093	R-Square	0.0020	
Dependent Mean		1.32143	Adj R-Sq	-0.0102	
Coeff Var		65.90856			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.25789	0.18462	6.81	<.0001
T1AGE	1	0.01717	0.04279	0.40	0.6892

TABLE F21

Independent variable T2AGE

At what age did your child stop taking fluoride tablets or drops?

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.82185	1.82185	2.65	0.1084
Error	65	44.68561	0.68747		
Corrected Total	66	46.50746			
Root MSE		0.82914	R-Square	0.0392	
Dependent Mean		1.14925	Adj R-Sq	0.0244	
Coeff Var		72.14583			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.49710	0.23647	6.33	<.0001
T2AGE	1	-0.07530	0.04626	-1.63	0.1084

TABLE F22

Independent variable TAB1
How many fluoride tablets did/does your child take at a time from birth to 6 months of age?
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TAB1

FLU		TAB1			Total
Frequency	Col Pct	0	1	2	
0	35.9 26.59	0 0.00	1 100.00		360
1	463 34.30	0 0.00	0 0.00		463
2	425 31.48	1 100.00	0 0.00		426
3	83 6.15	0 0.00	0 0.00		83
4	13 0.96	0 0.00	0 0.00		13
5	7 0.52	0 0.00	0 0.00		7
Total	1350	1	1		1352

Comparisons
No comparisons were attempted

TABLE F23

Independent variable DROP1
How many fluoride drops did/does your child take at a time from birth to 6 months of age?
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by DROP1

FLU		DROP1			Total
Frequency	Col Pct	0	1	2	
0		357 26.64	2 25.00	1 25.00	360
1		459 34.25	2 25.00	2 50.00	463
2		421 31.42	4 50.00	1 25.00	426
3		83 6.19	0 0.00	0 0.00	83
4		13 0.97	0 0.00	0 0.00	13
5		7 0.52	0 0.00	0 0.00	7
Total		1340	8	4	1352

Comparisons
Across frequencies

Statistics for Table of FLU by DROP1

Fisher's Exact Test	
Table Probability (P)	0.1818
Pr <= P	0.7576

TABLE F24

Independent variable TAB2
How many fluoride tablets did/does your child take at a time from 6 months to 4 years of age?
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TAB2				
FLU	TAB2			
Frequency Col Pct	0	1	2	Total
0	355 26.85	4 14.81	1 33.33	360
1	454 34.34	8 29.63	1 33.33	463
2	412 31.16	13 48.15	1 33.33	426
3	81 6.13	2 7.41	0 0.00	83
4	13 0.98	0 0.00	0 0.00	13
5	7 0.53	0 0.00	0 0.00	7
Total	1322	27	3	1352

Comparisons
Across frequencies

Statistics for Table of FLU by TAB2

Fisher's Exact Test	
Table Probability (P)	0.1552
Pr <= P	0.7983

TABLE F25

Independent variable DROP2
How many fluoride drops did/does your child take at a time from 6 months to 4 years of age?
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by DROP2

FLU		DROP2				Total
Frequency	Col Pct	0	1	2	3	
0		355 26.67	1 12.50	3 27.27	1 50.00	360
1		457 34.34	2 25.00	4 36.36	0 0.00	463
2		417 31.33	5 62.50	3 27.27	1 50.00	426
3		82 6.16	0 0.00	1 9.09	0 0.00	83
4		13 0.98	0 0.00	0 0.00	0 0.00	13
5		7 0.53	0 0.00	0 0.00	0 0.00	7
Total		1331	8	11	2	1352

Comparisons
Across frequencies

Statistics for Table of FLU by DROP2

Fisher's Exact Test	
Table Probability (P)	0.0095
Pr <= P	0.7138

TABLE F26

Independent variable TAB3

How many fluoride tablets did/does your child take at a time over 4 years of age?

Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TAB3

FLU		TAB3			Total
Frequency	Col Pct	0	1	2	
0		354 27.00	6 16.67	0 0.00	360
1		449 34.25	13 36.11	1 20.00	463
2		406 30.97	16 44.44	4 80.00	426
3		82 6.25	1 2.78	0 0.00	83
4		13 0.99	0 0.00	0 0.00	13
5		7 0.53	0 0.00	0 0.00	7
Total		1311	36	5	1352

Comparisons
Across frequencies

Statistics for Table of FLU by TAB3

Fisher's Exact Test	
Table Probability (P)	0.0905
Pr <= P	0.5031

TABLE F27

Independent variable DROP3
How many fluoride drops did/does your child take at a time over 4 years of age?
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by DROP3

FLU		DROP3				
Frequency		0	1	2	4	Total
Col	Pct					
0	354 26.54	3 25.00	3 60.00	0 0.00	360	
1	460 34.48	2 16.67	1 20.00	0 0.00	463	
2	418 31.33	7 58.33	0 0.00	1 100.00	426	
3	82 6.15	0 0.00	1 20.00	0 0.00	83	
4	13 0.97	0 0.00	0 0.00	0 0.00	13	
5	7 0.52	0 0.00	0 0.00	0 0.00	7	
Total	1334	12	5	1	1352	

Comparisons
Across frequencies

Statistics for Table of FLU by DROP3

Fisher's Exact Test	
Table Probability (P)	0.0043
Pr <= P	0.0973

TABLE F28

Independent variable TOF1
How often did /does your child take the number of tablets or drops from birth to 6 months?
TOF1 values: 1 = more than once a day, 2 = once a day, 3 = 5 to 6 times a week, 4 = 2 to 4 times a week, 5 = once a week, 6 = infrequently/varied, 7 = did not take at this age.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TOF1

FLU	TOF1						Total
	Frequency Col Pct	0	1	2	4	6	7
0	347 26.71	0 0.00	5 38.46	0 0.00	0 0.00	8 22.86	360
1	446 34.33	1 100.00	2 15.38	1 33.33	1 100.00	12 34.29	463
2	406 31.25	0 0.00	6 46.15	2 66.67	0 0.00	12 34.29	426
3	80 6.16	0 0.00	0 0.00	0 0.00	0 0.00	3 8.57	83
4	13 1.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	13
5	7 0.54	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	7
Total	1299	1	13	3	1	35	1352

Comparisons
Across categories (1,2) (3,4) (5,6)
Dean (0) (1) (2)

Statistics for Table of FLU by TOF1

Fisher's Exact Test	
Table Probability (P)	0.0458
Pr <= P	0.5033

TABLE F29

Independent variable TOF2
How often did /does your child take the number of tablets or drops from birth to 6 months?
TOF2 values: 1 = more than once a day, 2 = once a day, 3 = 5 to 6 times a week, 4 = 2 to 4 times a week, 5 = once a week, 6 = infrequently/varied, 7 = did not take at this age.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TOF2

FLU	TOF2									
Frequency										
Col Pct	0	1	2	3	4	5	6	7		Total
0	342 26.76	0 0.00	11 28.95	0 0.00	1 14.29	0 0.00	2 40.00	4 22.22		360
1	440 34.43	2 66.67	9 23.68	1 100.00	4 57.14	0 0.00	2 40.00	5 27.78		463
2	397 31.06	1 33.33	16 42.11	0 0.00	2 28.57	2 100.00	1 20.00	7 38.89		426
3	79 6.18	0 0.00	2 5.26	0 0.00	0 0.00	0 0.00	0 0.00	2 11.11		83
4	13 1.02	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00		13
5	7 0.55	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00		7
Total	1278	3	38	1	7	2	5	18		1352

Comparisons
Across categories (1,2) (3,4) (5,6)
Dean (0) (1) (2) (3)

Statistics for Table of FLU by TOF2	
Fisher's Exact Test	
Table Probability (P)	0.0018
Pr <= P	0.6959

TABLE F30

Independent variable TOF3
How often did /does your child take the number of tablets or drops from birth to 6 months?
TOF3 values: 1 = more than once a day, 2 = once a day, 3 = 5 to 6 times a week, 4 = 2 to 4 times a week, 5 = once a week, 6 = infrequently/varied, 7 = did not take at this age.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by TOF3

FLU	TOF3								
Frequency Col Pct	0	1	2	3	4	5	6	7	Total
0	341 26.87	0 0.00	10 25.00	1 50.00	0 0.00	1 20.00	4 28.57	3 17.65	360
1	438 34.52	1 50.00	10 25.00	1 50.00	2 66.67	2 40.00	3 21.43	6 35.29	463
2	390 30.73	1 50.00	19 47.50	0 0.00	1 33.33	2 40.00	5 35.71	8 47.06	426
3	80 6.30	0 0.00	1 2.50	0 0.00	0 0.00	0 0.00	2 14.29	0 0.00	83
4	13 1.02	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	13
5	7 0.55	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	7
Total	1269	2	40	2	3	5	14	17	1352

Comparisons
Across categories (1,2) (3,4) (5,6)
Dean (0) (1) (2) (3)

Statistics for Table of FLU by TOF3	
Fisher's Exact Test	
Table Probability (P)	5.716E-04
Pr <= P	0.5606

TABLE F31

Independent variable FRIN
Has your child ever used fluoride mouthrinse?
FRIN values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by FRIN

FLU		FRIN				Total
Frequency						
Col	Pct	0	1	2	3	
0		2 10.00	25 22.94	321 27.02	12 34.29	360
1		8 40.00	31 28.44	414 34.85	10 28.57	463
2		6 30.00	37 33.94	375 31.57	8 22.86	426
3		4 20.00	16 14.68	59 4.97	4 11.43	83
4		0 0.00	0 0.00	13 1.09	0 0.00	13
5		0 0.00	0 0.00	6 0.51	1 2.86	7
Total		20	109	1188	35	1352

Comparisons
Across categories (1) (2) (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by FRIN

Statistic	DF	Value	Prob
Chi-Square	6	15.0332	0.0200

TABLE F32

Independent variable RAGE1
At what age did your child start using fluoride mouthrinse?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.01642	0.01642	0.02	0.8983
Error	93	92.97306	0.99971		
Corrected Total	94	92.98947			
Root MSE		0.99986	R-Square	0.0002	
Dependent Mean		1.41053	Adj R-Sq	-0.0106	
Coeff Var		70.88525			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.45695	0.37651	3.87	0.0002
RAGE1	1	-0.00625	0.04878	-0.13	0.8983

TABLE F33

Independent variable RAGE2
At what age did your child stop using fluoride mouthrinse?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.11258	0.11258	0.11	0.7483
Error	17	17.99268	1.05839		
Corrected Total	18	18.10526			
	Root MSE	1.02878	R-Square	0.0062	
	Dependent Mean	1.31579	Adj R-Sq	-0.0522	
	Coeff Var	78.18745			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.04073	0.87578	1.19	0.2510
RAGE2	1	0.03134	0.09610	0.33	0.7483

TABLE F34

Independent variable ROF1
How often did/does your child use fluoride mouthrinse at the following times when he/she started using it?
ROF1 values: 1 = every day, 2 = a few times a week, 3 = once a week, 4 = infrequently.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by ROF1

FLU		ROF1					
Frequency							
Col	Pct	0	1	2	3	4	Total
0		338 27.00	3 25.00	4 21.05	2 11.76	13 25.00	360
1		433 34.58	4 33.33	3 15.79	9 52.94	14 26.92	463
2		393 31.39	3 25.00	9 47.37	4 23.53	17 32.69	426
3		68 5.43	2 16.67	3 15.79	2 11.76	8 15.38	83
4		13 1.04	0 0.00	0 0.00	0 0.00	0 0.00	13
5		7 0.56	0 0.00	0 0.00	0 0.00	0 0.00	7
Total		1252	12	19	17	52	1352

Comparisons
Across categories (1) (2) (3) (4)
Dean (0) (1) (2) (3)

Statistics for Table of FLU by ROF1

Fisher's Exact Test	
Table Probability (P)	4.127E-07
Pr <= P	0.6231

TABLE F35

Independent variable ROF2

How often did/does your child use fluoride mouthrinse at the following times now or when he/she stopped using it?

ROF2 values: 1 = every day, 2 = a few times a week, 3 = once a week, 4 = infrequently.

Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by ROF2

FLU		ROF2				
Frequency						
Col Pct	0	1	2	3	4	Total
0	337 26.85	4 40.00	7 38.89	3 17.65	9 17.31	360
1	434 34.58	3 30.00	3 16.67	8 47.06	15 28.85	463
2	395 31.47	3 30.00	4 22.22	3 17.65	21 40.38	426
3	69 5.50	0 0.00	4 22.22	3 17.65	7 13.46	83
4	13 1.04	0 0.00	0 0.00	0 0.00	0 0.00	13
5	7 0.56	0 0.00	0 0.00	0 0.00	0 0.00	7
Total	1255	10	18	17	52	1352

Comparisons

Across categories (1) (2) (3) (4)

Dean (0) (1) (2) (3)

Statistics for Table of FLU by ROF2

Fisher's Exact Test

Table Probability (P)	7.089E-08
Pr <= P	0.2264

TABLE F36

Independent variable FGEL1
Has your child ever had fluoride gel applied to his/her teeth by the School Dental Service?
FGEL1 values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by FGEL1

FLU		FGEL1				Total
Frequency	Col Pct	0	1	2	3	
0		67 24.01	23 34.33	193 26.22	77 28.52	360
1		88 31.54	21 31.34	259 35.19	95 35.19	463
2		103 36.92	18 26.87	229 31.11	76 28.15	426
3		19 6.81	3 4.48	45 6.11	16 5.93	83
4		1 0.36	1 1.49	7 0.95	4 1.48	13
5		1 0.36	1 1.49	3 0.41	2 0.74	7
Total		279	67	736	270	1352

Comparisons
Across categories (1) (2) (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by FGEL1

Statistic	DF	Value	Prob
Chi-Square	6	2.8843	0.8232

TABLE F37

Independent variable FGEL1X
How many times fluoride gel was applied to his/her teeth by the School Dental Service?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.01751	0.01751	0.01	0.9097
Error	54	72.83964	1.34888		
Corrected Total	55	72.85714			
Root MSE		1.16141	R-Square	0.0002	
Dependent Mean		1.14286	Adj R-Sq	-0.0183	
Coeff Var		101.62371			

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.11441	0.29401	3.79	0.0004
FGEL1X	1	0.01751	0.15366	0.11	0.9097

TABLE F38

Independent variable FGEL2
Has your child ever had fluoride gel applied to his/her teeth in private dental practice?
FGEL2 values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by FGEL2

FLU		FGEL2				Total
Frequency	Col Pct	0	1	2	3	
0		35 27.34	84 25.93	207 26.78	34 26.77	360
1		44 34.38	106 32.72	260 33.64	53 41.73	463
2		36 28.13	115 35.49	246 31.82	29 22.83	426
3		11 8.59	17 5.25	45 5.82	10 7.87	83
4		1 0.78	1 0.31	11 1.42	0 0.00	13
5		1 0.78	1 0.31	4 0.52	1 0.79	7
Total		128	324	773	127	1352

Comparisons
Across categories (1) (2) (3)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by FGEL2

Statistic	DF	Value	Prob
Chi-Square	6	8.4881	0.2045

TABLE F39

Independent variable FGEL2X
How many times fluoride gel was applied to his/her teeth in private dental practice?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.02646	0.02646	0.03	0.8588
Error	307	256.25185	0.83470		
Corrected Total	308	256.27832			
Root MSE		0.91362	R-Square	0.0001	
Dependent Mean		1.23948	Adj R-Sq	-0.0032	
Coeff Var		73.70960			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.25028	0.07985	15.66	<.0001
FGEL2X	1	-0.00483	0.02711	-0.18	0.8588

TABLE F40

Independent variable FGEL3
Has your child ever had fluoride gel applied to his/her teeth at home?
FGEL3 values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by FGEL3

FLU		FGEL3				Total
Frequency	Col Pct	0	1	2	3	
0		89 26.25	3 37.50	264 26.99	4 14.81	360
1		108 31.86	1 12.50	343 35.07	11 40.74	463
2		117 34.51	4 50.00	297 30.37	8 29.63	426
3		21 6.19	0 0.00	58 5.93	4 14.81	83
4		2 0.59	0 0.00	11 1.12	0 0.00	13
5		2 0.59	0 0.00	5 0.51	0 0.00	7
Total		339	8	978	27	1352

Comparisons
Across categories (1,3) and (2)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by FGEL3

Statistic	DF	Value	Prob
Chi-Square	3	1.4484	0.6942

TABLE F41

Independent variable FGEL3X
How many times fluoride gel was applied to his/her teeth at home?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.76959	1.76959	2.42	0.1638
Error	7	5.11930	0.73133		
Corrected Total	8	6.88889			
Root MSE		0.85518	R-Square	0.2569	
Dependent Mean		1.11111	Adj R-Sq	0.1507	
Coeff Var		76.96600			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.71180	0.47998	3.57	0.0091
FGEL3X	1	-0.14611	0.09393	-1.56	0.1638

TABLE F42

Independent variable WF
Years spent in a water fluoridated area.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.72258	0.72258	0.76	0.3833
Error	1317	1250.98629	0.94988		
Corrected Total	1318	1251.70887			
Root MSE		0.97462	R-Square	0.0006	
Dependent Mean		1.21380	Adj R-Sq	-0.0002	
Coeff Var		80.29469			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.12571	0.10450	10.77	<.0001
WF	1	0.01007	0.01154	0.87	0.3833

TABLE F43

Independent variable EXPOSURE
Varying exposure to fluoridated water (from 1 to 5 years, during the first 6 years of life)
EXPOSURE values: 0 = lifelong exposure, 1 = 5 years of exposure, 2 = 4 years of exposure, 3 = 3 years of exposure, 4 = 2 years of exposure, 5 = 1 year of exposure.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by EXPOSURE

FLU	EXPOSURE						
Frequency Col Pct	0	1	2	3	4	5	Total
0	270 28.33	30 19.74	11 20.37	13 37.14	8 23.53	7 21.88	339
1	304 31.90	62 40.79	23 42.59	13 37.14	11 32.35	15 46.88	428
2	305 32.00	47 30.92	18 33.33	8 22.86	11 32.35	9 28.13	398
3	56 5.88	12 7.89	1 1.85	1 2.86	4 11.76	1 3.13	75
4	12 1.26	0 0.00	1 1.85	0 0.00	0 0.00	0 0.00	13
5	6 0.63	1 0.66	0 0.00	0 0.00	0 0.00	0 0.00	7
Total	953	152	54	35	34	32	1260

Comparisons
Across categories (0) and (1,2,3,4,5)

Statistics for Table of FLU by EXPOSURE

Fisher's Exact Test	
Table Probability (P)	2.714E-07
Pr <= P	0.0671

TABLE F44

Independent variable FORM
Was your child ever fed infant formula?
FORM values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by FORM

FLU		FORM				
Frequency						
Col	Pct	0	1	2	3	Total
0		11 24.44	225 24.97	121 30.48	3 33.33	360
1		15 33.33	316 35.07	129 32.49	3 33.33	463
2		14 31.11	292 32.41	118 29.72	2 22.22	426
3		5 11.11	54 5.99	23 5.79	1 11.11	83
4		0 0.00	10 1.11	3 0.76	0 0.00	13
5		0 0.00	4 0.44	3 0.76	0 0.00	7
Total		45	901	397	9	1352

Comparisons
Across categories (1) and (2,3)

Statistics for Table of FLU by FORM

Fisher's Exact Test	
Table Probability (P)	1.734E-06
Pr <= P	0.3673

TABLE F45

Independent variable FORMIX
What did you usually add to the infant formula for your child?
FORMIX values: 1 = tap water - mains supply, 2 = carbon/charcoal filtered,
3 = osmosis/distillation filtered, 4 = mineral/spring water, 5 = tank water,
6 = unknown.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by FORMIX

FLU	FORMIX							
	0	1	2	3	4	5	6	Total
Frequency								
Col Pct								
0	139 30.22	157 22.79	10 35.71	2 14.29	7 31.82	43 32.33	2 33.33	360
1	152 33.04	241 34.98	3 10.71	3 21.43	7 31.82	54 40.60	3 50.00	463
2	134 29.13	238 34.54	10 35.71	8 57.14	5 22.73	30 22.56	1 16.67	426
3	29 6.30	41 5.95	5 17.86	1 7.14	2 9.09	5 3.76	0 0.00	83
4	3 0.65	9 1.31	0 0.00	0 0.00	1 4.55	0 0.00	0 0.00	13
5	3 0.65	3 0.44	0 0.00	0 0.00	0 0.00	1 0.75	0 0.00	7
Total	460	689	28	14	22	133	6	1352

Comparisons
Across categories (1) (2,3,4) (5,6)
Dean (0) (1) (2) (3,4,5)

Statistics for Table of FLU by FORMIX

Statistic	DF	Value	Prob
Chi-Square	6	21.3457	0.0016

TABLE F46

Independent variable PREM
Was your child born prematurely?
PREM values: 1 = yes, 2 = no, 3 = don't know.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by PREM

FLU		PREM				
Frequency						
Col	Pct	0	1	2	3	Total
0		43 38.05	24 20.00	292 26.19	1 25.00	360
1		34 30.09	46 38.33	381 34.17	2 50.00	463
2		29 25.66	39 32.50	358 32.11	0 0.00	426
3		7 6.19	10 8.33	65 5.83	1 25.00	83
4		0 0.00	0 0.00	13 1.17	0 0.00	13
5		0 0.00	1 0.83	6 0.54	0 0.00	7
Total		113	120	1115	4	1352

Comparisons
Across categories (1) and (2,3)

Statistics for Table of FLU by PREM

Fisher's Exact Test	
Table Probability (P)	2.424E-05
Pr <= P	0.3954

TABLE F47

Independent variable BWK
What was the birth weight of your child (in kilograms)?

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

The REG Procedure					
Dependent Variable: FLU					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.48338	0.48338	0.51	0.4761
Error	1191	1133.06734	0.95136		
Corrected Total	1192	1133.55071			
Root MSE		0.97538	R-Square	0.0004	
Dependent Mean		1.25314	Adj R-Sq	-0.0004	
Coeff Var		77.83434			
Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.35249	0.14221	9.51	<.0001
BWK	1	-0.02955	0.04146	-0.71	0.4761

TABLE F48

Independent variable KBORN
In which country was your child born?
KBORN values: 1 = Australia, 2 = overseas.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by KBORN				
FLU	KBORN			
Frequency				
Col Pct	0	1	2	Total
0	4 16.67	346 26.68	10 32.26	360
1	10 41.67	439 33.85	14 45.16	463
2	6 25.00	414 31.92	6 19.35	426
3	4 16.67	78 6.01	1 3.23	83
4	0 0.00	13 1.00	0 0.00	13
5	0 0.00	7 0.54	0 0.00	7
Total	24	1297	31	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by KBORN	
Fisher's Exact Test	
Table Probability (P)	0.0012
Pr <= P	0.5655

TABLE F49

Independent variable MBORN
In which country was mother born?
MBORN values: 1 = Australia, 2 = overseas.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by MBORN

FLU		MBORN			Total
Frequency	Col Pct	0	1	2	
0		4 14.81	300 26.91	56 26.67	360
1		12 44.44	388 34.80	63 30.00	463
2		7 25.93	343 30.76	76 36.19	426
3		4 14.81	68 6.10	11 5.24	83
4		0 0.00	11 0.99	2 0.95	13
5		0 0.00	5 0.45	2 0.95	7
Total		27	1115	210	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by MBORN

Fisher's Exact Test	
Table Probability (P)	9.651E-06
Pr <= P	0.4857

TABLE F50

Independent variable ENG
Is English the main language spoken at home?
ENG values: 1 = yes, 2 = no.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by ENG

FLU		ENG			Total
Frequency	Col Pct	0	1	2	
0		4 15.38	350 26.70	6 40.00	360
1		11 42.31	447 34.10	5 33.33	463
2		7 26.92	416 31.73	3 20.00	426
3		4 15.38	78 5.95	1 6.67	83
4		0 0.00	13 0.99	0 0.00	13
5		0 0.00	7 0.53	0 0.00	7
Total		26	1311	15	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by ENG

Fisher's Exact Test	
Table Probability (P)	0.0082
Pr <= P	0.6725

TABLE F51

Independent variable ABTS
Is your child of Aboriginal or Torres Strait Islander origin?
ABTS values: 1 = No, 2 = yes, Aboriginal, 3 = yes, Torres Strait Islander, 4 = yes, both.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by ABTS

FLU		ABTS					Total
Frequency	Col Pct	0	1	2	3	4	
0		5 17.24	350 27.15	4 12.90	0 0.00	1 50.00	360
1		12 41.38	437 33.90	13 41.94	1 100.00	0 0.00	463
2		8 27.59	405 31.42	12 38.71	0 0.00	1 50.00	426
3		4 13.79	79 6.13	0 0.00	0 0.00	0 0.00	83
4		0 0.00	11 0.85	2 6.45	0 0.00	0 0.00	13
5		0 0.00	7 0.54	0 0.00	0 0.00	0 0.00	7
Total		29	1289	31	1	2	1352

Comparisons
Across categories (1) and (2,3,4)

Statistics for Table of FLU by ABTS

Fisher's Exact Test	
Table Probability (P)	2.531E-05
Pr <= P	0.0470

TABLE F52

Independent variable SINGLE
Does your child live in a one-parent household?
SINGLE values: 1 = yes, 2 = no.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by SINGLE

FLU		SINGLE			Total
Frequency	Col Pct	0	1	2	
0		6 21.43	61 23.46	293 27.54	360
1		11 39.29	93 35.77	359 33.74	463
2		7 25.00	84 32.31	335 31.48	426
3		4 14.29	19 7.31	60 5.64	83
4		0 0.00	3 1.15	10 0.94	13
5		0 0.00	0 0.00	7 0.66	7
Total		28	260	1064	1352

Comparisons
Across categories (1) and (2)

Statistics for Table of FLU by SINGLE

Fisher's Exact Test	
Table Probability (P)	7.013E-06
Pr <= P	0.5267

TABLE F53

Independent variable ABTSM
Is father/male guardian of Aboriginal or Torres Strait Islander origin?
ABTSM values: 1 = No, 2 = yes, Aboriginal, 3 = yes, Torres Strait Islander, 4 = yes, both.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by ABTSM

FLU		ABTSM				Total
Frequency	Col Pct	0	1	2	3	
0		71 25.09	287 27.05	2 28.57	0 0.00	360
1		100 35.34	359 33.84	3 42.86	1 100.00	463
2		87 30.74	338 31.86	1 14.29	0 0.00	426
3		22 7.77	60 5.66	1 14.29	0 0.00	83
4		3 1.06	10 0.94	0 0.00	0 0.00	13
5		0 0.00	7 0.66	0 0.00	0 0.00	7
Total		283	1061	7	1	1352

Comparisons
Across categories (1) and (2,3,4)

Statistics for Table of FLU by ABTSM

Fisher's Exact Test	
Table Probability (P)	0.0149
Pr <= P	0.4208

TABLE F54

Independent variable ABTSF
Is mother/female guardian of Aboriginal or Torres Strait Islander origin?
ABTSF values: 1 = No, 2 = yes, Aboriginal, 3 = yes, Torres Strait Islander, 4 = yes, both.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by ABTSF

FLU		ABTSF				
Frequency						
Col Pct	0	1	2	3	4	Total
0	14 20.90	340 27.05	5 20.00	0 0.00	1 50.00	360
1	22 32.84	430 34.21	11 44.00	0 0.00	0 0.00	463
2	22 32.84	394 31.34	8 32.00	1 100.00	1 50.00	426
3	8 11.94	75 5.97	0 0.00	0 0.00	0 0.00	83
4	1 1.49	11 0.88	1 4.00	0 0.00	0 0.00	13
5	0 0.00	7 0.56	0 0.00	0 0.00	0 0.00	7
Total	67	1257	25	1	2	1352

Comparisons
Across categories (1) and (2,3,4)

Statistics for Table of FLU by ABTSF

Fisher's Exact Test	
Table Probability (P)	7.749E-04
Pr <= P	0.3884

TABLE F55

Independent variable EDM
What is the highest level of education of father/male guardian?
EDM values: 1 = some high school, 2 = completed high school,
3 = some vocational training, 4 = completed vocational training,
5. some university or college, 6. completed university or college.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by EDM

FLU		EDM							Total
Frequency	Col Pct	0	1	2	3	4	5	6	
0		73 25.09	38 19.39	71 30.34	41 28.47	72 31.30	18 27.27	47 24.61	360
1		103 35.40	74 37.76	77 32.91	53 36.81	69 30.00	20 30.30	67 35.08	463
2		89 30.58	67 34.18	69 29.49	42 29.17	71 30.87	22 33.33	66 34.55	426
3		23 7.90	16 8.16	13 5.56	4 2.78	13 5.65	6 9.09	8 4.19	83
4		3 1.03	0 0.00	3 1.28	2 1.39	3 1.30	0 0.00	2 1.05	13
5		0 0.00	1 0.51	1 0.43	2 1.39	2 0.87	0 0.00	1 0.52	7
Total		291	196	234	144	230	66	191	1352

Comparisons
Across categories (1,2) (3,4) (5,6)
Dean (0) (1) (2) (3) (4,5)

Statistics for Table of FLU by EDM

Statistic	DF	Value	Prob
Chi-Square	8	7.3547	0.4989

TABLE F56

Independent variable EDF
What is the highest level of education of mother/female guardian?
EDF values: 1 = some high school, 2 = completed high school,
3 = some vocational training, 4 = completed vocational training,
5. some university or college, 6. completed university or college.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by EDF

FLU	EDF							
	0	1	2	3	4	5	6	Total
Frequency								
Col Pct								
0	13 18.84	47 22.82	121 29.09	23 24.21	37 24.67	37 27.61	82 29.08	360
1	26 37.68	71 34.47	135 32.45	32 33.68	55 36.67	52 38.81	92 32.62	463
2	20 28.99	68 33.01	129 31.01	30 31.58	48 32.00	42 31.34	89 31.56	426
3	9 13.04	17 8.25	20 4.81	9 9.47	9 6.00	3 2.24	16 5.67	83
4	1 1.45	1 0.49	7 1.68	1 1.05	1 0.67	0 0.00	2 0.71	13
5	0 0.00	2 0.97	4 0.96	0 0.00	0 0.00	0 0.00	1 0.35	7
Total	69	206	416	95	150	134	282	1352

Comparisons
Across categories (1,2) (3,4) (5,6)
Dean (0) (1) (2) (3) (4,5)

Statistics for Table of FLU by EDF

Statistic	DF	Value	Prob
Chi-Square	8	14.1486	0.0780

TABLE F57

Independent variable JOBM
What is father/male guardian's usual occupation?
JOBM values: 1 = managers and administrators, 2 = professionals,
3 = associate professionals, 4 = tradespersons and related workers,
5 = advanced clerical and service workers,
6 = intermediate clerical and service workers,
7 = intermediate production/transport workers,
8 = elementary clerical and service workers, 9 = labourers.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by JOBM

FLU		JOBM					
Frequency							
Col	Pct	0	1	2	3	4	Total
0		83 25.46	23 25.56	34 31.48	40 29.20	95 29.14	360
1		116 35.58	28 31.11	38 35.19	47 34.31	102 31.29	463
2		99 30.37	33 36.67	29 26.85	43 31.39	102 31.29	426
3		24 7.36	4 4.44	5 4.63	6 4.38	21 6.44	83
4		3 0.92	2 2.22	2 1.85	0 0.00	2 0.61	13
5		1 0.31	0 0.00	0 0.00	1 0.73	4 1.23	7
Total		326	90	108	137	326	1352
(Continued)							

Table of FLU by JOBM

FLU	JOBM					
Frequency						
Col Pct	5	6	7	8	9	Total
0	9 23.08	10 20.83	11 17.74	4 18.18	51 26.29	360
1	13 33.33	18 37.50	23 37.10	8 36.36	70 36.08	463
2	13 33.33	15 31.25	21 33.87	6 27.27	65 33.51	426
3	3 7.69	4 8.33	5 8.06	3 13.64	8 4.12	83
4	1 2.56	1 2.08	2 3.23	0 0.00	0 0.00	13
5	0 0.00	0 0.00	0 0.00	1 4.55	0 0.00	7
Total	39	48	62	22	194	1352

Comparisons
Across categories (1,2,3) (4,5,6) (7,8,9)
Dean (0) (1) (2) (3) (4,5)

Statistics for Table of FLU by JOBM

Statistic	DF	Value	Prob
Chi-Square	8	5.1446	0.7420

TABLE F58

Independent variable JOBF
What is mother/female guardian's usual occupation?
JOBF values: 1 = managers and administrators, 2 = professionals,
3 = associate professionals, 4 = tradespersons and related workers,
5 = advanced clerical and service workers,
6 = intermediate clerical and service workers,
7 = intermediate production/transport workers,
8 = elementary clerical and service workers, 9 = labourers.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)
FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild,
4 = moderate, 5 = severe.

Table of FLU by JOBF

FLU	JOBF					
Frequency						
Col Pct	0	1	2	3	4	Total
0	113 25.86	16 36.36	15 36.59	96 27.75	16 19.05	360
1	153 35.01	7 15.91	12 29.27	121 34.97	28 33.33	463
2	135 30.89	17 38.64	11 26.83	107 30.92	33 39.29	426
3	29 6.64	3 6.82	3 7.32	17 4.91	6 7.14	83
4	5 1.14	0 0.00	0 0.00	3 0.87	0 0.00	13
5	2 0.46	1 2.27	0 0.00	2 0.58	1 1.19	7
Total (Continued)	437	44	41	346	84	1352

The FREQ Procedure

Table of FLU by JOBF

FLU		JOBF				
Frequency						
Col Pct	5	6	7	8	9	Total
0	48 24.62	39 30.47	1 14.29	7 31.82	9 18.75	360
1	71 36.41	40 31.25	4 57.14	6 27.27	21 43.75	463
2	66 33.85	41 32.03	2 28.57	5 22.73	9 18.75	426
3	9 4.62	5 3.91	0 0.00	3 13.64	8 16.67	83
4	1 0.51	3 2.34	0 0.00	0 0.00	1 2.08	13
5	0 0.00	0 0.00	0 0.00	1 4.55	0 0.00	7
Total	195	128	7	22	48	1352

Comparisons

Across categories (1,2,3) (4,5,6) (7,8,9)
Dean (0) (1) (2) (3) (4,5)

Statistics for Table of FLU by JOBF

Statistic	DF	Value	Prob
Chi-Square	8	18.0480	0.0209

TABLE F59

Independent variable INC

Which category does your total household income (before tax) fall into?
INC values: 1 = up to \$20,000, 2 = \$20,001 to \$40,000, 3 = \$40,001 to \$60,000, 4 = \$60,001 to \$80,000, 5 = \$80,001 to \$100,000, 6 = over \$100,000.
Note: 0 = missing values.

Dependent variable FLU (Dean fluorosis score)

FLU values: 0 = normal, 1 = questionable, 2 = very mild, 3 = mild, 4 = moderate, 5 = severe.

Table of FLU by INC

FLU	INC							
Frequency	0	1	2	3	4	5	6	Total
Col Pct								
0	33 24.26	31 21.23	92 31.51	65 22.65	77 27.02	37 31.09	25 28.74	360
1	55 40.44	51 34.93	92 31.51	104 36.24	93 32.63	36 30.25	32 36.78	463
2	38 27.94	52 35.62	85 29.11	91 31.71	96 33.68	39 32.77	25 28.74	426
3	10 7.35	11 7.53	16 5.48	24 8.36	12 4.21	5 4.20	5 5.75	83
4	0 0.00	1 0.68	4 1.37	3 1.05	3 1.05	2 1.68	0 0.00	13
5	0 0.00	0 0.00	3 1.03	0 0.00	4 1.40	0 0.00	0 0.00	7
Total	136	146	292	287	285	119	87	1352

Comparisons

Across categories (1,2,3) (4,5,6) (7,8,9)
Dean (0) (1) (2) (3) (4,5)

Statistics for Table of FLU by INC

Statistic	DF	Value	Prob
Chi-Square	6	3.4740	0.7474

Appendix H: Kappa value calculation tables

Inter-examiner kappa value at the beginning of the survey

The FREQ Procedure

Table of Ikreet by Prof

Ikreet		Prof			
Frequency	Col Pct	0	1	2	3
		Total	Total	Total	Total
0		14 87.50	1 6.67	0 0.00	0 0.00
1		2 12.50	13 86.67	0 0.00	0 0.00
2		0 0.00	1 6.67	22 95.65	0 0.00
3		0 0.00	0 0.00	1 4.35	5 100.00
Total		16	15	23	5

Statistics for Table of Ikreet by Prof

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	0.8799	0.0511	0.7797	0.9802
Weighted Kappa	0.9198	0.0346	0.8519	0.9876

Sample Size = 59

Inter-examiner kappa value towards the end of the survey

The FREQ Procedure

Table of Ikreet by Prof

Ikreet Prof						
Frequency	Col Pct					
		0	1	2	3	4
0		6 75.00	0 0.00	0 0.00	0 0.00	0 0.00
1		2 25.00	25 100.00	0 0.00	0 0.00	0 0.00
2		0 0.00	0 0.00	23 100.00	0 0.00	0 0.00
3		0 0.00	0 0.00	0 0.00	2 100.00	0 0.00
4		0 0.00	0 0.00	0 0.00	0 0.00	1 100.00
Total		8	25	23	2	1

Statistics for Table of Ikreet by Prof

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	0.9469	0.0366	0.8753	1.0186
Weighted Kappa	0.9593	0.0282	0.9040	1.0146

Sample Size = 59

Intra-examiner kappa value at the beginning of the survey

The FREQ Procedure

Table of Ikreet by Ike

Ikreet		Ikreet					Total
Frequency	Col Pct	0	1	2	3	4	
0		6 85.71	0 0.00	0 0.00	0 0.00	0 0.00	6
1		1 14.29	26 100.00	0 0.00	0 0.00	0 0.00	27
2		0 0.00	0 0.00	23 95.83	0 0.00	0 0.00	23
3		0 0.00	0 0.00	1 4.17	1 100.00	0 0.00	2
4		0 0.00	0 0.00	0 0.00	0 0.00	1 100.00	1
Total		7	26	24	1	1	59

Statistics for Table of Ikreet by Ike

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	0.9459	0.0371	0.8732	1.0187
Weighted Kappa	0.9578	0.0289	0.9011	1.0146

Sample Size = 59

Intra-examiner kappa value towards the end of the survey

The FREQ Procedure

Table of Ikreet by Ike

Ikreet		Ikreet				Total
Frequency	Col Pct	1	2	3	4	
1		5 100.00	0 0.00	0 0.00	0 0.00	5
2		0 0.00	6 100.00	0 0.00	0 0.00	6
3		0 0.00	0 0.00	5 100.00	0 0.00	5
4		0 0.00	0 0.00	0 0.00	1 100.00	1
Total		5	6	5	1	17

Statistics for Table of Ikreet by Ike

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	1.0000	0.0000	1.0000	1.0000
Weighted Kappa	1.0000	0.0000	1.0000	1.0000

Sample Size = 17

Appendix I: Russell's differential diagnosis criteria for fluorosis

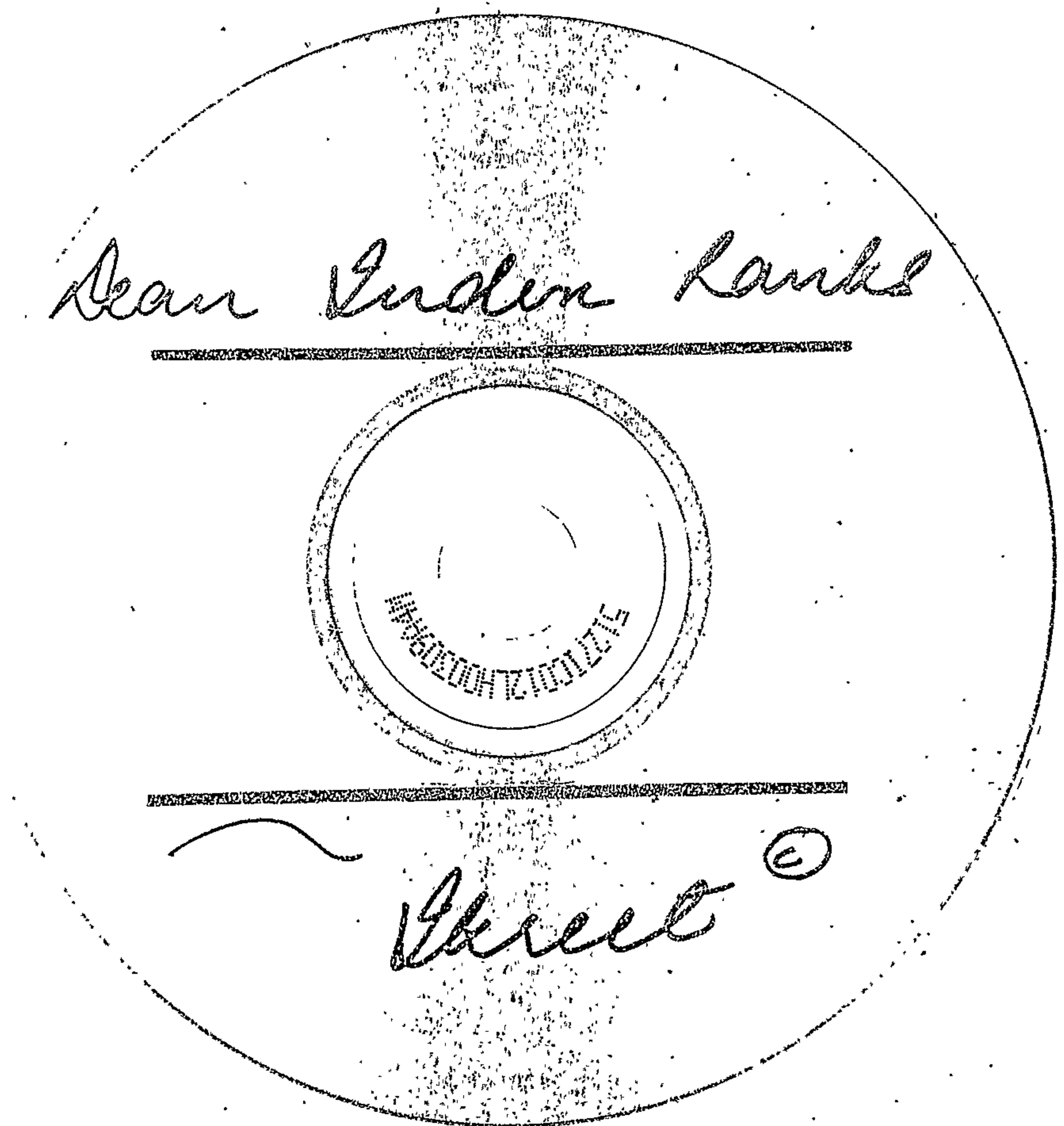
The Russell differential criteria were used to assess presence or absence of fluorosis (Russell, 1961).

Russell's differential diagnosis criteria for fluorosis

Characteristics	Dental fluorosis	Enamel Opacities
Area affected	The entire tooth surfaces (all surfaces) often enhanced on or near tips of incisal edge.	Usually centred in smooth surface of limited extent.
Lesion shape	Resemble line shading in pencil sketch, which follow incremental lines in enamel (perikymata). Lines merging and cloudy appearance. At incisal edges formation of irregular white caps ("snow cap").	Round or oval.
Demarcation	Diffuse distribution over the surface of varying intensity.	Clearly differentiated from adjacent normal enamel.
Colour	Opaque white lines or clouds; even chalky appearance. "Snow cap" at incisal edge. Some lesions may become brownish discoloured at mesio-incisal part of central upper incisors after eruption.	White opaque or creamy-yellow to dark reddish-orange at time of eruption.
Teeth affected	Always on homologous teeth. Early erupting teeth (incisors/first molars) least affected. Premolars and second molars (and third molars) most severely affected	Most common on labial surfaces of single or occasionally homologous teeth. Any teeth may be affected but mostly incisors.

Appendix J: Photographic examples of Dean Index ranks

Supplement



There was no significant difference in the prevalence of fluorosis with respect to the age of the children (Table S1).

Table S1: Distribution of children with respect to age at examination (in years)

Fluorosis Rank	Age in years									Total
	5	6	7	8	9	10	11	12	13	
Normal	1	3	27	63	72	71	70	52	1	360
Questionable	0	5	41	90	106	94	65	57	5	463
Very mild	2	5	30	79	80	86	81	61	2	426
Mild	0	1	7	20	15	10	15	14	1	83
Moderate	0	0	1	5	2	1	2	2	0	13
Severe	0	0	0	2	0	3	0	2	0	7
Total	3	14	106	259	275	265	233	188	9	1352
CFI	0.67	0.68	0.64	0.72	0.61	0.63	0.64	0.70	0.72	0.66

There was no significant difference observed in the CFI values of males and females in Blue Mountains and Hawkesbury (Table S2).

Table S2: Community Fluorosis Index (CFI) by sex and region

Fluorosis Rank	Blue Mountains		Hawkesbury		Overall		Total
	Male	Female	Male	Female	Male	Female	
Normal	59	54	127	120	186	174	360
Questionable	113	126	119	105	232	231	463
Very mild	85	96	109	136	194	232	426
Mild	18	15	22	28	40	43	83
Moderate	4	4	4	1	8	5	13
Severe	1	3	1	2	2	5	7
Total	280	298	382	392	662	690	1352
CFI	0.69	0.71	0.60	0.65	0.64	0.68	0.66

It was observed that more than 70 percent of the children started brushing their teeth before the age of two years (Table S3).

Table S3: Distribution of children with respect to age (in years) when toothbrushing commenced

Fluorosis Rank	Age in years*							
	0.5	1	1.5	2	2.5	3	3.5	4
Normal	42	83	55	75	14	45	5	17
Questionable	59	115	57	112	22	47	9	21
Very mild	33	125	59	83	24	44	13	22
Mild	8	15	16	15	3	13	2	3
Moderate	1	4	2	3	1	2	0	0
Severe	2	2	0	2	0	1	0	0
Total	145	344	189	290	64	152	29	63
Cummulative %age	10.7	36.1	50.1	71.5	76.2	87.4	89.5	94.2
CFI	0.62	0.68	0.66	0.64	0.69	0.68	0.74	0.61

* Distribution is shown till 4 years of age as the maxillary anterior teeth are susceptible to fluorosis during this development period.

Missing/excluded data - 76.

Fluorosis levels in selected studies were similar. There were two outliers – Riordan (1993a) and Evans (1998). Measures taken in Western Australia to reduce fluorosis were successful (Riordan, 2002). It appears that fluorosis levels are lower in Melbourne than elsewhere in Australia (Table S4).

Table S4: Fluorosis prevalence comparison using the 95% CI

Study	Country	Prevalence	95% CI
Riordan and Banks, 1991	Western Australia	0.40	0.32 - 0.48
Riordan, 1993a	Western Australia	0.48	0.43 - 0.53
Riordan, 2002	Western Australia	0.22	0.18 - 0.26
Puzio and Spencer, 2001	South Australia	0.35	0.30 - 0.40
Evans <i>et al.</i> , 1998	Melbourne	0.15	0.12 - 0.18
Loh, 1996	Singapore	0.38	0.36 - 0.40
Pendrys, 2000	U.S.A.	0.34	0.28 - 0.40
Bal <i>et al.</i> , 2005	Sydney	0.39	0.36 - 0.42