

**FLUORIDE EXPOSURE,
DENTAL FLUOROSIS AND CARIES
AMONG SOUTH AUSTRALIAN CHILDREN**

by

Loc Giang Do

Submitted for the degree of

Doctor of Philosophy

Dental School

Supervised by Professor A John Spencer

The University of Adelaide

2004

Table of Contents

Table of Content	i
List of figures	vi
List of tables	vii
Abstract	xii
1. Introduction.....	1
1.1 Background.....	1
1.2 Rationale.....	3
1.3 Research framework.....	4
1.4 Study hypothesis.....	5
1.5 Specific objectives	5
2. Fluoride and oral health	6
2.1 Fluoride exposure – overview.....	6
2.1.1 Availability, absorption, excretion and metabolism of fluoride.....	6
2.1.2 Potential sources of fluoride exposure	7
2.1.3 Fluoride intake.....	8
2.1.4 Fluoride exposure measurement.....	10
2.2 Dental fluorosis among children – review of current evidence	12
2.2.1 Aetiology and clinical appearance of dental fluorosis	12
2.2.2 Historical trend of dental fluorosis	13
2.2.3 The prevalence and severity of dental fluorosis among Australian children.....	14
2.2.4 Risk factors for dental fluorosis.....	15
2.2.4.1 Fluoridated water	16
2.2.4.2 Fluoride toothpaste.....	17
2.2.4.3 Fluoride supplements.....	18
2.2.4.4 Fluoride from foods.....	19
2.3 Dental caries among Australian children.....	19
2.3.1 Prevalence and severity of dental caries among Australian children.....	19
2.3.2 Caries and fluoride exposure.....	20
2.4 Effect of a change in fluoride exposure on the pattern of dental fluorosis and caries..	21
2.5 Dental appearance – perception and psychological impact	23
2.6 Initiatives to control fluoride exposure in Australia.....	25
2.7 Early evaluation of the policy initiatives	26
3. Research Methodology	28
3.1 Study design	28
3.1.1 The Child Oral Health Study	28
3.1.2 Sampling strategy for this nested study.....	29
3.1.2.1 Study design	29
3.1.2.2 Sample size	32
3.1.3 Ethical clearance	33
3.2 Data collection instruments and methods of execution	33
3.2.1 Child Oral Health Study questionnaire.....	33
3.2.2 Dental caries measurement.....	34

3.2.3	The measurement of dental fluorosis.....	34
3.2.3.1	Approaches in the measurement of fluorosis	34
3.2.3.2	Differential diagnosis of fluorosis.....	35
3.2.3.3	Fluorosis indices available	35
3.2.3.3.1	The Dean Index (Dean, 1934)	35
3.2.3.3.2	The Thystrup & Fejerskov (TF) Index	36
3.2.3.3.3	The Fluorosis Risk Index (FRI).....	38
3.2.3.3.4	The Tooth Surface Index of Fluorosis (TSIF).....	40
3.2.3.4	Assessment of fluorosis in this study	40
3.2.4	Dental Aesthetic Index	41
3.2.5	Perception of dental health.....	42
3.2.5.1	Dental appearance perception.....	42
3.2.5.2	Child Perception questionnaire and Parental Perception questionnaire	42
3.2.6	Data collection procedures	43
3.2.6.1	Child Oral Health Study data collection.....	43
3.2.6.2	Perception questionnaire data collection.....	44
3.2.6.3	Dental caries data collection	44
3.2.6.4	Fluorosis examination procedures.....	45
3.2.6.4.1	Appointment for examination	45
3.2.6.4.2	Examiner training	45
3.2.6.4.3	Examination procedures	45
3.2.6.4.4	Reliability analysis	46
3.3	Statistical approach	48
3.3.1	Data re-weighting	48
3.3.2	Data management.....	48
3.3.2.1	Management of fluoride exposure measurements.....	48
3.3.2.1.1	Estimation of lifetime exposure to fluoride in water	49
3.3.2.1.2	Fluoride exposure from toothpaste	50
3.3.2.2	Management of fluorosis data.....	51
3.3.2.3	Dental caries data management.....	51
3.3.2.4	Perception questionnaire data management.....	53
3.3.2.4.1	Dental Aesthetic Index.....	53
3.3.2.4.2	Dental appearance items.....	53
3.3.2.4.3	Dental health perception items	53
3.3.3	Analytic plan	54
3.3.3.1	Plan to address specific aims of the study	54
3.3.3.2	Building multivariate models.....	56
3.3.3.2.1	Multivariate models for dental fluorosis.....	56
3.3.3.2.2	Multivariate models for dental caries	57
3.3.3.2.3	Multivariate models for perception of dental health.....	57
3.3.3.2.4	Population attributable risk calculation.....	58
4.	Results.....	60
4.1	Response.....	61
4.2	The study sample description	65

4.2.1	The initial study sample	65
4.2.2	Dental visits collected from the School Dental Service archive	66
4.2.3	Respondents to the dental perception questionnaire	67
4.2.4	Fluorosis examination participants	68
4.2.5	Comparison of study participants and the initial study sample	69
4.2.6	Socioeconomic status of the study sample.....	70
4.3	Dietary pattern of the study population.....	72
4.4	Fluoride exposures among South Australian children.....	73
4.4.1	Exposure to fluoride from water	73
4.4.2	Exposure to fluoridated toothpaste	78
4.4.3	Exposure to other sources of fluoride.....	89
4.5	Dental fluorosis among South Australian children	91
4.5.1	Fluorosis examination data using the TF Index	91
4.5.2	Fluorosis examination data using the Fluorosis Risk Index.....	93
4.5.3	The prevalence of dental fluorosis	95
4.5.3.1	The prevalence of dental fluorosis defined by the TF index	95
4.5.3.2	The prevalence of dental fluorosis defined by the FRI.....	97
4.5.4	Comparison of the two indices.....	98
4.5.5	Time trend of dental fluorosis	99
4.5.6	The relationship of fluoride exposure with the prevalence and severity of fluorosis	102
4.5.6.1	The effects of frequency and amount of fluoride exposure on the experience of fluorosis.....	102
4.5.6.1.1	The prevalence and severity of fluorosis defined by the TF index and exposure to fluoride	102
4.5.6.1.2	The prevalence and severity of fluorosis defined by the Fluorosis Risk Index and exposure to fluoride.....	109
4.5.6.2	Stratified analyses of the prevalence of fluorosis by lifetime exposure to fluoride in water and toothbrushing practice	112
4.5.7	Risk factors for dental fluorosis.....	116
4.5.7.1	Logistic regression models for having dental fluorosis defined by the TF index.....	116
4.5.7.2	Logistic regression models for having dental fluorosis defined by the FRI Classification I and II.....	121
4.5.7.3	Summary of risk factors for dental fluorosis	127
4.5.7.4	Population attributable risk for dental fluorosis	129
4.6	Dental caries among South Australian children.....	131
4.6.1	The prevalence and severity of dental caries.....	131
4.6.1.1	The prevalence and severity of dental caries among 8–13-year-old South Australian children.....	131
4.6.1.2	Dental caries experience at different anchor ages	133
4.6.1.3	Dental caries experience of the study sample by fluoride exposure status.....	135
4.6.1.3.1	Caries experience by fluoride exposure status at the time of the study in 2002/03	135
4.6.1.3.2	Caries experience by fluoride exposure status at age six.....	138
4.6.1.3.3	Caries experience by fluoride exposure status at age eight.....	140

4.6.2	Cohort trend of dental caries.....	142
4.6.3	Stratified analysis of dental caries experience by lifetime exposure to fluoride in water and toothbrushing practice.....	144
4.6.4	Multivariate models of dental caries among South Australian children 8–13 years old in 2002/03	149
4.7	Perception of dental appearance and oral health of South Australian children	157
4.7.1	Dental Aesthetic Index scores	157
4.7.2	Global items of the dental appearance, oral health and oral health impact.....	160
4.7.3	Construct validity of the perception questionnaires.....	164
4.7.4	Perception of dental appearance by fluorosis status	166
4.7.5	Perception of oral health-related quality of life.....	172
4.7.5.1	Perception of oral health-related quality of life by birth cohort.....	172
4.7.5.2	The perception of oral health-related quality of life by fluorosis status	173
4.7.5.3	The perception of oral health-related quality of life by caries status.....	176
4.8	Fluoride exposure, dental fluorosis, caries and oral health-related quality of life	179
4.8.1	The association between fluorosis and caries in relation to exposures to fluoride	179
4.8.2	Determinants of the perception of oral health-related quality of life.....	184
5.	Discussion	188
5.1	Overview – strengths and limitations	188
5.2	Exposure to fluoride among South Australian children.....	192
5.2.1	Overview of exposure measurement	192
5.2.2	Exposure to fluoride among South Australian children	194
5.2.2.1	Exposure to fluoride in water.....	194
5.2.2.2	Exposure to fluoride toothpaste.....	195
5.2.3	Exposure to other discretionary fluoride sources	196
5.2.4	Summaries of exposure to fluoride	197
5.3	Dental fluorosis among South Australian children.....	198
5.3.1	Dental fluorosis measurement in the study population.....	198
5.3.2	Dental fluorosis experience in the study population.....	199
5.3.3	Trend of dental fluorosis in South Australian children.....	200
5.4	Risk factors for dental fluorosis among South Australian children.....	202
5.4.1	Epidemiological fundamentals of risk assessment	202
5.4.2	Risk factors for fluorosis among South Australian children.....	203
5.4.2.1	Exposure to fluoride in water.....	204
5.4.2.2	Fluoride toothpaste	205
5.4.2.3	Other factors.....	208
5.4.2.3.1	Sex	208
5.4.2.3.2	Fluoride supplements and infant formula	208
5.4.3	Population attributable risk for dental fluorosis in the study population.....	209
5.5	Dental caries among South Australian children.....	210
5.5.1	The prevalence and severity of dental caries among South Australian children ...	210
5.5.2	Fluoride exposure, dental caries relationship.....	211
5.5.2.1	Exposure to fluoridated water and dental caries.....	211
5.5.2.2	Exposure to fluoride toothpaste and dental caries.....	212

5.5.3	Time trend of dental caries among South Australian children.....	213
5.6	The perception of dental appearance and oral health-related quality of life of South Australian children	215
5.6.1	Perception of dental appearance	215
5.6.2	Perception of oral health-related quality of life.....	216
5.7	Fluoride exposure, dental fluorosis and caries: a working balance.....	217
5.7.1	Exposure to fluoridated water	219
5.7.2	Exposure to fluoride toothpaste	220
5.7.2.1	Type of toothpaste used when toothbrushing is commenced.....	220
5.7.2.2	Age of commencement of toothbrushing with toothpaste	221
5.7.2.3	Frequency of toothbrushing	221
5.7.2.4	Amount of toothpaste used per brushing	222
5.7.2.5	Eating and/or licking toothpaste habits.....	222
5.7.3	Water fluoridation and fluoride toothpaste, a synchronised approach	223
5.7.4	Suggested guidelines for a synchronised fluoride use.....	224
5.8	Implications of the study findings.....	225
5.8.1	Research implications	225
5.8.2	Implications for population oral health.....	227
6.	Conclusion	229
	Bibliography.....	232
	Appendix 1:.....	243
	The Child Oral Health Study's questionnaire	243
	Appendix 2:	257
	Manual for Staff of School Dental Service	257
	Appendix 3:.....	281
	The Child Perception and Parental Perception questionnaires	281
	Appendix 4:.....	301
	Clinical examination manual.....	301

List of Figures

Figure 3.1: Study sample selection and data collection scheme.....	31
Figure 4.1: Cumulative percentage of DAI scores of 8–13-year-old children	158
Figure 4.2: Trend of deciduous and permanent caries by experience of fluorosis defined as having TF score 1+ on upper central incisors.....	179

List of Tables

Table 2.1: Distribution of TF and TSIF scores among a sample of South Australian children, 1992	15
Table 2.2: Oral health predictors of four aspects of appearance and psychosocial impact among South Australian children, 1993.....	24
Table 3.1: Differential diagnostic criteria for dental fluorosis	35
Table 3.2: The Dean Index	36
Table 3.3: Criteria for the Thylstrup and Fejerskov (TF) Index.....	37
Table 3.4: Surface zone classifications by the FRI	38
Table 3.5: Criteria for the Fluorosis Risk Index (FRI).....	39
Table 3.6: The Tooth Surface Index of Fluorosis (TSIF).....	40
Table 3.7: Procedures required in preparing teeth for each of the fluorosis indices	41
Table 3.8: Reliability scores by the TF Index	47
Table 4.1: Enrolment rate and response rate to the Child Oral Health Study in South Australia	61
Table 4.2: Response rate of the study by age group and residency.....	62
Table 4.3: Response rate of the study sample by sex, residential location and birth cohorts	63
Table 4.4: Weights of the sample by birth cohort and clinics	64
Table 4.5: Distribution of the initial study sample by year of birth, sex and current residency	65
Table 4.6: Age at fluorosis examination by birth cohorts	65
Table 4.7: Number of SA SDS recorded examinations at different anchor ages by birth cohort	66
Table 4.8: Distribution of the respondents to the perception questionnaire by birth cohorts, sex and current residency	67
Table 4.9: Distribution of the study participants by birth cohorts, sex and current residency.....	68
Table 4.10: The initial study sample, non-participants, and fluorosis examination participants by dental caries experience	69
Table 4.11: Socioeconomic status of the study sample by birth cohorts	71
Table 4.12: Frequency of several foods and drinks consumed in the study population in 2002/03	72
Table 4.13: Proportion of lifetime of South Australian children spent in a fluoridated area by sex, residential location, and birth cohorts.....	73
Table 4.14: Public water consumption by South Australian children.....	74
Table 4.15: Cross-tabulation of lifetime exposure to fluoride in water and exposure to fluoride until age six.....	74
Table 4.16: Study participants by lifetime exposure to fluoride in water and exposure to fluoride in water until age six.....	76
Table 4.17: Study participants place of birth by sex, current residence and birth cohort	77
Table 4.18: Age started brushing with toothpaste	79
Table 4.19: Frequency of brushing when started, at age 5 and at the time of the study (2002/03).....	81
Table 4.20: Type of toothpaste used when started, at age 5 and at the time of the study (2002/03)	83
Table 4.21: Amount of toothpaste used when started, at age 5 and at the time of the study (2002/03)....	85
Table 4.22: Eating and/or licking toothpaste habit when started brushing, and at age five	86
Table 4.23: Components of toothbrushing practice by lifetime exposure to fluoride in water.....	88
Table 4.24: Use of fluoride supplement and fluoride mouth rinsing in the childhood	89
Table 4.25: Use of infant formula in the study sample	90
Table 4.26: Per cent of teeth examined for the TF index	91
Table 4.27: Distribution of participants with different severity scores of TF index	92
Table 4.28: Percentage of FRI classification I and II surface zones examined for fluorosis	93
Table 4.29: Distribution of children with different FRI scores on Classification I surface zones	94

Table 4.30: Distribution of children with different FRI scores on Classification II surface zones	94
Table 4.31: The prevalence of dental fluorosis defined as having one or more upper teeth with different TF scores	95
Table 4.32: The prevalence of dental fluorosis defined as having one or more central incisors with different TF scores	96
Table 4.33: The FRI Classification I and II cases by sex and current residence	97
Table 4.34: Fluorosis Risk Index Classification I by Classification II status	98
Table 4.35: Cross-tabulation of cases and control defined by the two indices	98
Table 4.36: Trend in the prevalence of dental fluorosis defined as having one or more teeth with different TF scores	99
Table 4.37: Trend in the prevalence of dental fluorosis defined as having one or more upper central incisors with different TF scores	100
Table 4.38: Trend in severity of fluorosis defined as TF scores on central incisors	101
Table 4.39: Trend in the prevalence of dental fluorosis defined by FRI classification I and II case definitions	101
Table 4.40: Prevalence of fluorosis defined as having different TF score on central incisors by use of toothpaste	103
Table 4.41: Prevalence of fluorosis defined as TF score 1+ on central incisors by exposure to fluoride in water and other sources of fluoride	105
Table 4.42: Distribution of TF scores on central incisors by pattern of toothpaste use	107
Table 4.43: Distribution of TF scores on central incisors by exposure to fluoride in water and other discretionary fluoride	108
Table 4.44: Distribution of FRI cases by patterns of toothbrushing practice at different times	110
Table 4.45: Distribution of FRI cases by exposure to fluoride in water and other discretionary fluoride	111
Table 4.46: The prevalence of fluorosis by lifetime exposure and age started brushing	112
Table 4.47: The prevalence of fluorosis by lifetime exposure and type of toothpaste used when brushing started and at age five	113
Table 4.48: The prevalence of fluorosis by lifetime exposure and frequency of brushing when brushing started and at age five	113
Table 4.49: The prevalence of fluorosis by lifetime exposure and amount of toothpaste used when brushing started and at age five	114
Table 4.50: The prevalence of fluorosis by lifetime exposure and eating, licking toothpaste habit when brushing started and at age five	115
Table 4.51: Logistic regression of prevalence of fluorosis defined as TF score 1+ on central incisors	117
Table 4.52: Logistic regression model of prevalence of dental fluorosis defined as TF score 2+ on the central incisors	119
Table 4.53: Logistic regression model of prevalence of dental fluorosis defined as TF score 2+ on the central incisors without type of toothpaste when toothbrushing started and at age five	120
Table 4.54: Logistic regression model of FRI Classification I cases of fluorosis	122
Table 4.55: Logistic regression model of FRI Classification II cases of fluorosis	124
Table 4.56: Logistic regression model of FRI Classification I and II cases of fluorosis	126
Table 4.57: Summary of all logistic regression models for fluorosis	127
Table 4.58: Estimated population attributable risk (PAR) for specific fluoride sources associated with the prevalence of fluorosis defined as TF score 1+ on central incisors	129
Table 4.59: Estimated population attributable risk (PAR) for specific fluoride sources associated with the prevalence of fluorosis defined as TF score 2+ on central incisors	130
Table 4.60: Prevalence of dental caries in the South Australian children in 2002/03	131
Table 4.61: Mean dental caries of the South Australian children aged 8–13 years in 2002/03	132

Table 4.62: Dental caries experience among the South Australian children at different ages by sex and residential location.....	134
Table 4.63: Dental caries experience in the South Australian children aged 8–13 years old in 2002/03 by toothbrushing practice	136
Table 4.64: Dental caries experience among South Australian children aged 8–13 years old in 2002/2003 by exposure to fluoride in water and other sources of fluoride	137
Table 4.65: Caries experience among South Australian children at age six by exposure to fluoride	139
Table 4.66: Caries experience among South Australian children at age eight by exposure to fluoride..	141
Table 4.67: Prevalence of dental caries by birth cohort.....	142
Table 4.68: Dental caries experience at different ages by birth cohort.....	143
Table 4.69: Deciduous caries experience at age six and eight by lifetime exposure to fluoride to age six and age started toothbrushing.....	144
Table 4.70: Deciduous caries experience at age six and eight by lifetime exposure to fluoride to age six and type of toothpaste used when brushing started and at age five.....	145
Table 4.71: Deciduous caries experience at age six and eight by lifetime exposure to fluoride and frequency of brushing when brushing started and at age five	146
Table 4.72: Deciduous caries experience at age six and eight by lifetime exposure to fluoride and amount of toothpaste used when brushing started and at age five.....	147
Table 4.73: Deciduous caries experience at age six and eight by lifetime exposure to fluoride and an eating, licking toothpaste habit when brushing started and at age five	148
Table 4.74: Linear regression model for deciduous dmfs at the time of the study	150
Table 4.75: Linear regression model for permanent DMFS at the time of the study.....	152
Table 4.76: Linear regression model for deciduous caries experience at age six	154
Table 4.77: Linear regression model for deciduous caries experience at age eight	156
Table 4.78: The ten components of the Dental Aesthetic Index	157
Table 4.79: Mean DAI scores of 8–13-year-old South Australian children by sex, residency and year of birth.....	158
Table 4.80: Dental Aesthetic Index score by perception of shape and alignment of front teeth	159
Table 4.81: Satisfaction with the appearance of front teeth by sex and residential location.....	161
Table 4.82: The global item of oral health by sex and residential location.....	162
Table 4.83: The global item of impact of oral health by sex and residential location	163
Table 4.84: Spearman rank correlation of the four domains scales scores with the global rating of oral health.....	164
Table 4.85: Spearman rank correlation of the four domains scales scores with the global rating of impact of oral health on quality of life	164
Table 4.86: Internal consistency of items included in domains by parent and children	165
Table 4.87: Perception of front teeth colour by fluorosis status on upper central incisors	166
Table 4.88: Perception of staining of front teeth by fluorosis status on upper incisors	167
Table 4.89: Perception of need for treatment to change colour of teeth by fluorosis status	169
Table 4.90: Satisfaction with dental appearance by fluorosis status of upper incisors	170
Table 4.91: Perception of dental appearance by birth cohort.....	171
Table 4.92: Oral health perception by birth cohort	172
Table 4.93: Responses to the global item of oral health by fluorosis status on upper incisors.....	173
Table 4.94: Responses to the global item of the impact of oral health by fluorosis status of upper incisors	174
Table 4.95: Perception of oral health domains by fluorosis score on upper central incisors	175
Table 4.96: Responses to the global item of oral health by the prevalence of dental caries	176
Table 4.97: Responses to the global item of impact of oral health by the prevalence of dental caries...	177

Table 4.98: Perception of oral health domains by the prevalence of deciduous and permanent dental caries	178
Table 4.99: Dental caries and fluorosis experience of children with different levels of lifetime exposure to fluoride in water	180
Table 4.100: Dental caries and fluorosis experience of children with age started toothbrushing	181
Table 4.101: Dental caries and fluorosis experience of children with components of toothbrushing practice when toothbrushing started.....	182
Table 4.102: Dental caries and fluorosis experience of children with an eating and/or licking toothpaste habit when toothbrushing started.....	183
Table 4.103: Linear regression models for oral health perception domains scores reported by children	185
Table 4.104: Linear regression models for oral health perception domains scores reported by parents	187

Notes

References

Reference to published work was made in the text by listing the author(s) and date of publication in parentheses. References were listed in the Bibliography in alphabetical order of authors and date order where there were multiple references for an author. To uniquely identify each reference in the text, up to three authors were included. Where there were four or more authors, the first author was named, followed by “et al.” in the text. All the authors were listed in the Bibliography.

List of Abbreviations

ARCPOH	Australian Research Centre for Population Oral Health
CDC	The Centre for Disease Control
CFS	The Child Fluoride Study
COHS	The Child Oral Health Study
COHQoL	Child oral health-related quality of life
CPQ	Child Perception questionnaire
DAI	Dental Aesthetic Index
DEJ	Dentino-enamel junction
DMFS	Decayed, missing and filled permanent tooth surface
dmfs	Decayed, missing and filled deciduous tooth surface
F	Fluoride
FRI	The Fluorosis Risk Index
MRC	The Medical Research Council
NHMRC	The National Health and Medical Research Council
OHRQoL	Oral health-related quality of life
PPQ	Parental Perception questionnaire
SA	South Australia
SADS	South Australian Dental Service
SD	Standard deviation
SDS	School Dental Service
TF	The Thylstrup and Fejerskov Index of fluorosis
TSIF	The Tooth Surface Index of Fluorosis

Abstract

The use of fluoride involves a balance between the protective effect against caries and the risk of having fluorosis. Fluorosis in Australian children was highly prevalent in the early 1990s. Policy initiatives were introduced to control fluoride exposure so as to reduce the prevalence of fluorosis.

Objective:

The study aimed of describing the prevalence, severity and risk factors for fluorosis, and to describe the trend of fluorosis among South Australian children. The study also aimed of exploring the effect of the change in fluoride exposure on dental fluorosis and caries.

Methods

This research project was nested in a larger population-based study, the Child Oral Health Study (COHS) in Australia 2002–2005. The parent study's sample was chosen using a multistage, stratified random selection with probability of selection proportional to population size. Fluoride exposure history was retrospectively collected by a parental questionnaire. This nested study sample (n=1401) was selected from the pool of South Australian (SA) COHS participants. Children were selected by year of birth to form three birth cohorts: those born in 1989/90; 1991/92; and 1993/94. Children were approached in two further stages: a dental health perception questionnaire, and a clinical examination for fluorosis. Some 898 children took part in the first stage. Among those, one trained dentist examined 677 children for fluorosis under clinic conditions using two indices (the Fluorosis Risk Index (Pendrys, 1990) and the TF Index (Thylstrup and Fejerskov, 1978)). The Dental Aesthetic Index score (DAI) was also recorded. Caries experience extracted from dental records of all previous visits to school dental clinics was used to enable calculation of dmfs/DMFS scores at different anchor ages.

Data were re-weighted age and sex to represent the South Australian child population. Per cent lifetime exposure to fluoride in water and patterns of discretionary fluoride use were calculated. Fluorosis data were used to calculate the prevalence and severity of fluorosis. Caries dmfs/DMFS scores were calculated at different anchor ages to enable comparison between birth cohorts.

Results

A higher proportion of children in the later birth cohorts used low concentration fluoride toothpaste, and a smaller amount of toothpaste was used when they commenced toothbrushing. There was a significant decline in the prevalence of fluorosis across the three successive birth cohorts. Risk factors for fluorosis, defined by the two indices, were use of

standard fluoride toothpaste, an eating and/or licking toothpaste habit, and exposure to fluoridated water. Means (SD) of the deciduous caries dmfs scores at age six and eight were 1.45 (3.11) and 2.46 (3.93) respectively. Evaluation of the “trade-off” between fluorosis and caries with fluoride exposure indicated that the use of low concentration fluoride toothpaste and preventing an eating/licking of toothpaste habit could reduce the prevalence of fluorosis without a significant increase in caries experience.

Conclusion

There was a marked decline in the prevalence of fluorosis across the three successive birth cohorts. The decline was linked with the reduction in exposure to fluoride. Exposure to fluoridated water and several components of toothpaste use were risk factors for fluorosis. Establishing an appropriate use of fluoride toothpaste could be successful in reducing fluorosis without a significant increase in caries experience.

Declaration

This work contains no material which has been accepted for the award of any degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give my consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Signed: _____
Loc Giang Do

___ / ___ / ___

Acknowledgements

I wish to express my sincere gratitude to Professor A. John Spencer of The University of Adelaide for his thorough supervision of this project and for his endless guidance and encouragement throughout the research process and writing-up the thesis.

I wish to thank the help and guidance from Dr Anna Puzio, Dr Kaye F Roberts-Thomson and Professor Gary D Slade of The University of Adelaide, whose contributions were important to successful completion of my research. The generous help of Professor Steven Levy of the University of Iowa in providing training materials and sharing experience is highly appreciated.

I would like to specially thank Mr Jason M Armfield, Ms Carmen Koster, and many others in the Child Oral Health Study's team, whose work has played major roles in setting up of this project.

I would like to acknowledge The University of Adelaide in providing my scholarship during 2001-2004, and the South Australian Dental Service in organising the fieldwork in 2003/04. Assistance from the staff of the eight SADS clinics that were sites of the study is specially appreciated.

I would like to express gratitude to Ms Dana Teusner for help with database, Ms Anne Ellershaw for weighting the data, Dr Suzanna Mihailidis and Ms Liana Luzzi for their encouragement and their help in editing the thesis, Mrs Judy Stewart for help with the questionnaires, Mrs Silvana Marveggio and Mrs Lorna Lucas for help with administrative matters, and all the friendly staff of Australian Research Centre for Population Oral Health at the University Adelaide for their highly qualified assistance during the study.

I want to express my dearest love to my family, who always support and encourage me in my study and in my life. Their love and help are essential for my life and career.