Summary of the Thesis

Title: Fluoride Exposure, Dental Fluorosis and Caries in South Australian Children

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Introduction

The use of fluoride in the prevention of dental caries requires balancing the positive benefits against the negative risks. The desire to maintain the caries preventive benefits of fluoride at the same time as reducing the risk of dental fluorosis led to policy initiatives in Australia in the early 1990s to target a reduction in exposure to fluoride from discretionary sources, namely from fluoride toothpastes, infant formula and fluoride supplementation of children up to six years old. If the initiatives have been widely implemented and were effective, the prevalence of fluorosis among children born at or after their introduction would be reduced without significant increase in caries experience.

Aims

The specific objectives of the research project were:

1. to describe the prevalence and severity of fluorosis among 8–13-year-old South Australian children in 2002/2003
2. to evaluate the effect of change in fluoride exposure in early childhood on the prevalence and severity of fluorosis
3. to quantify the perception of oral health and dental appearance among children and their parents in relation to fluorosis and other contributing factors
4. to evaluate the effect of change in fluoride exposure in childhood on dental caries experience
5. to identify appropriate measures to balance fluoride exposure by evaluating the "trade-off" between caries and fluorosis.

Hypothesis

The principal hypothesis being tested in this study was that the policies initiated in the early 1990s were effective in reducing the prevalence and severity of fluorosis without any effect on dental caries experience.

Methods

Study design and data collection

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 multistage, stratified

random selection with probability of selection proportional to population size. Fluoride exposure history was retrospectively collected by a parental questionnaire detailing past exposure to all sources of fluoride. The COHS fieldwork in South Australia has achieved a response rate of 67%.

This nested study sample (n=1401) was selected from the pool of South Australian COHS participants. Children were selected by year of birth to form three birth cohort groups: born in 1989/90; 1991/92; and, 1993/94. Subjects were approached in two further stages: a child and parent dental health perception questionnaire, and a clinical examination for fluorosis. Some 898 children took part in the stage one. Among those, a single 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)). Dental Aesthetic Index score (DAI) was also recorded. Caries experience from all previous visits at school dental clinics was extracted from paper-based and computerised clinical records to enable calculation of dmfs/DMFS scores at two anchor ages: six and eight years, and at the time of the study.

Data analysis

Data were re-weighted to correct for differences in sampling ratios and participation rates so as to represent the SA child population. Fluoride exposure measurements were calculated from the COHS parental questionnaire data. These measurements were percent lifetime exposure to fluoride in water and patterns of discretionary fluoride use. Fluorosis data were used to calculate the prevalence and severity of fluorosis. Caries dmfs/DMFS scores were calculated at different ages to enable comparison between birth cohorts.

Univariate and bivariate statistics were used to describe the population estimates of fluorosis and caries. Stratified analyses were also employed to explore association between different fluoride exposures and fluorosis and caries. The trends of fluorosis and caries between birth cohorts were examined at different time points. Multivariate models were generated to identify risk factors for fluorosis and caries. Population attributable risks for fluorosis were calculated for exposures to fluoride. A trade-off between fluorosis and caries with different fluoride exposure sources was examined in stratified analyses. Benefits and risks of exposures were then evaluated.

Results

A higher proportion of children in later birth cohorts used low fluoride toothpaste, and used a smaller amount of toothpaste when they commenced toothbrushing. There was also a trend of reduction in percent lifetime exposure to fluoridated water. A total of 145 children (25.8%) had a TF score of 1+ and 57 (11.4%) had a TF score of 2+. There was a significant decline in the prevalence of fluorosis across the three successive birth cohorts. This decline was found to be related to the use of low concentration fluoride toothpaste. Risk factors for fluorosis, defined by the two indices for fluorosis,

were use of standard fluoride toothpaste, eating and/or licking toothpaste, and exposure to fluoride in water. Estimated population attributable risks indicated that exposure to fluoridated water was attributed to 40% and 53% of fluorosis cases defined as having a TF score of 1+ and 2+, respectively. Eating and/or licking toothpaste in early year was attributed to more than a third of cases of fluorosis. Another quarter of fluorosis cases could be attributed to the use of 1000-ppm fluoride toothpaste when toothbrushing was started.

Mean deciduous caries dmfs (SD) at age six and eight were 1.45 (3.11) and 2.46 (3.93) respectively. The "trade-off" between fluorosis and caries with exposure to water fluoridation was strong, namely reducing exposure to fluoride in water could reduce the prevalence of fluorosis as well as significantly increase caries experience. On the other hand, commencing toothbrushing between 18 to 30 months of age, use of low fluoride toothpaste, and preventing eating/licking of toothpaste could reduce the prevalence of fluorosis without a significant increase in caries experience. Perception of tooth colour was related to fluorosis scores on upper anterior teeth. Perception of poorer oral health was related to dental caries experience and occlusal traits. Dental fluorosis experience did not have a negative impact on perception of oral health of the affected children or their parent.

Conclusion

The study drew the following conclusions.

- A quarter of children aged 8 to 13 in South Australia had some fluorosis. The vast majority of fluorosis cases had a TF score of 1 or 2. The prevalence of fluorosis in the study population was lower than that reported from other comparable studies.
- There was a marked decline in the prevalence of fluorosis across the birth cohorts. This decline was found to be related to the increased use of low concentration fluoride toothpaste in the latest birth cohort.
- There was a tendency of increasing dental caries experience in the study population. This might be explained mainly by a reduction in fluoride exposure, namely reduced the percent of lifetime exposure to fluoride in water, and use of lower concentration of toothpaste.
- Exposure to fluoridated water remained one of the most effective measures against caries, which if modified to prevent fluorosis could result in significant increase in caries. Eliminating swallowing of toothpaste such as eating and/or licking toothpaste could significantly reduce the prevalence of fluorosis without impact on caries experience.
- The benefits of water fluoridation were affirmed. Recommendations regarding the use of fluoride toothpaste should take into account exposure to fluoridated water to achieve a more appropriate combination of exposures to fluoride to balance the risk and benefit of fluoride use.