ENVIRONMENTAL EFFECTS

Environmental hazards of fluoride in volcanic ash: a case study from Ruapehu volcano, New Zealand.

The vent-hosted hydrothermal system of Ruapehu volcano is normally covered by an approximately 10 million m$^3$ acidic crater lake where volcanic gases accumulate. Through analysis of eruption observations, granulometry, mineralogy, and chemistry of volcanic ash from the 1995-1996 Ruapehu eruptions, we report on the varying influences on environmental hazards associated with the deposits. All measured parameters are more dependent on the eruptive style than on distance from the vent. Early phreatic and phreatomagmatic eruption phases from crater lakes similar to that on Ruapehu are likely to contain the greatest concentrations of environmentally significant elements, esp. sulfur and fluoride. These elements are contained within altered xenolithic material ejected from the hydrothermal system by steam explosions, as well as in residual hydrothermal fluids adsorbed on to particle surfaces. In particular, total F in the ash may be enriched by a factor of 6 relative to original magmatic contents, although immediately soluble F does not show such dramatic increases. Highly soluble NaF and CaSiF$_6$ phases, demonstrated to be the carriers of available F in purely magmatic eruptive systems, are probably not dominant in the products of phreatomagmatic eruptions through hydrothermal systems. Instead, slowly soluble compounds such as CaF$_2$, AlF$_3$, and Ca$_5$(PO$_4$)$_3$F dominate. Fluoride in these phases is released over longer periods, where only one third is leached in a single 24-hr water extraction. This implies that estimation of soluble F in such ashes based on a single leach leads to underestimation of the F impact, especially of a potential longer-term environmental hazard. In addition, a large proportion of the total F in the ash is apparently soluble in the digestive system of grazing animals. In the Ruapehu case this led to several thousand sheep deaths from fluorosis.

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Keywords: Volcano chemistry; Granulometry; Mineralogy; Ruapehu Volcano, NZ; Sheep deaths; Sulfur emissions; Volcanic eruptions.
EFFECTS ON TEETH

Is attention-deficit hyperactivity disorder a risk factor for dental caries? A case-control study

Experience in practice has suggested that children with attention-deficit hyperactivity disorder (ADHD) tend to have higher numbers of diseased, missing, and filled teeth (DMFT score) than children without the condition. To date, however, this impression has not been systematically investigated. A case-control study of children in Otago, New Zealand (case DMFT $\geq 5$; control DMFT <5; case status determined from School Dental Service dental records) was conducted by postal survey and reference to the School Dental Service records. Cases and controls were matched on age, sex, ethnicity, and school socio-economic status. The purpose of the study was to assess whether having ADHD was associated with higher odds of having high caries experience. Questionnaires were returned for a total of 128 case-control pairs. Conditional logistical regression analysis showed that, after controlling for fluoride history, medical problems, diet, and self-reported oral hygiene, children with ADHD had nearly 12 times the odds of having a high DMFT score than children who did not have ADHD (OR = 11.98; 95% CI 1.13, 91.81). No other factors were significant predictors. Dental practitioners and parents should consider ADHD to be a condition that may affect children's dental caries experience.

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Keywords: Attention-deficit hyperactivity disorder (ADHD); Dental caries.

Dental caries and beverage consumption in young children

OBJECTIVE: Dental caries is a common, chronic disease of childhood. We describe previously unknown associations among caries experience and intakes of dairy foods, sugared beverages, and nutrients and overall diet quality in young children. METHODS: Subjects (n = 642) are members of the Iowa Fluoride Study, a cohort followed from birth. Food and nutrient intakes were obtained from 3-day diet records analyzed annually for 5 years. Caries experience was assessed at both the tooth and the surface levels at 4 to 7 years of age. Data were analyzed using SAS. RESULTS: Subjects with caries had lower median intakes of milk, higher median intakes of regular (sugared) soda...
pop, regular beverages or total sugared beverages, or inadequate intake of nutrients than subjects without caries. CONCLUSIONS: Results of our study suggest that contemporary changes in beverage patterns, particularly the increase in soda pop consumption increases dental caries rates in children. Consumption of regular soda pop, regular powdered beverages, and, to a lesser extent, 100% juice was associated with increased caries risk. Milk had a neutral association with caries. Associations between different types of sugared beverages and caries experience were not equivalent, which could be attributable to the different sugar compositions of the beverages or different roles in the diet. Our data suggests consumption of 2 or more servings of dairy foods daily, limiting intake of 100% juice to 4 to 6 oz daily, and restricting other sugared beverages to occasional use.

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Keywords: Beverages; Dental caries; Fluoride; Young children.
Source: Pediatrics 2003;112(3 Pt 1);184-91.

Fluoride, beverages and dental caries in the primary dentition

Knowledge concerning risk factors for primary dentition caries in young children is incomplete. Models are presented for caries development using longitudinally gathered fluoride exposure and dietary intake data in the Iowa Fluoride Study. Primary tooth caries examinations were conducted at age 5. Dietary (beverage) and fluoride exposure data were gathered longitudinally from age 6 weeks through 4 years (n = 291); 23% had decayed or filled surfaces. Logistic regression revealed that beverage components and toothbrushing made unique contributions to caries experience. Water consumption (36-48 months), milk consumption (24-36 months), and fluoridated toothpaste brushings (36-48 months) were negatively associated with caries; sugared beverages and milk (6 weeks to 12 months) were positively associated. Although fluoride exposure is important, sugared beverages contribute substantially to caries risk, while water and milk consumption and frequent toothbrushing early can have protective effects.

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Keywords: Beverages; Dental caries; Fluoride; Iowa fluoride study; Primary dentition.
Abstracts

**Breastfeeding is protective against dental fluorosis in a nonfluoridated rural area of Ontario, Canada.**

To determine the relationship between early infant feeding and dental fluorosis in a non-fluoridated area, 1367 children were examined for fluorosis and given a water sample vial and questionnaire. 752 families responded (55%). Breastfeeding was reported by 69% of respondents, with 53.6% breastfed < 6 months, 35.3% 6-12 months, and 11.1% > 1 year. Formula feeding was reported by 84% of respondents, with 60.3% and 39.7% formula fed for < 1 year and > 1 year, respectively. Fluorosis prevalence was 23.3% and was present in 27.2%, 19.6% and 13.8% of children breastfed for < 6 months, 6-12 months, and > 12 months, respectively (p<0.05). About 87% of formula fed children had tap water added to the bottle. Breastfeeding for > 6 months may protect children from developing fluorosis in the permanent incisors. This study suggests that dental professionals should support efforts to increase the rate and duration of breastfeeding.

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Keywords: Breastfeeding; Dental fluorosis.

**HEALTH/BIOLOGICAL EFFECTS**

**Heavy iridocorneal angle hyperpigmentation and glaucoma associated with fluorosis**

Endemic fluorosis is a chronic crippling skeletal and dental disease caused by ingestion or inhalation of large amounts of fluoride. Although the prevalence of this disease has decreased considerably, it still occurs in some parts of the world. Our province Isparta is a naturally occurring endemic fluorosis area. The aim of this study was to investigate the ocular manifestations of the disorder in a group of patients with fluorosis. Fifty (32 F, 18 M) consecutive patients, ranging in age between 29 and 74 yr (54.44±12.28), with endemic fluorosis constituted the study group. Fifty consecutive age and sex matched patients without clinical findings of fluorosis were selected as controls. Both groups of patients underwent a routine ophthalmological examination. To assess the levels of hyperpigmentation in the anterior chamber angle, we constituted a grading system (scale 1 to 4) based on selected brownish colors from Pantone Color Formula Guide. The differences between the two groups with respect to serum, urine, and water fluoride levels were statistically sig-
significant (for all, p<0.001). With respect to iridocorneal angle hyperpigmentation (ICA HP) grades, the difference between fluorosis and control groups was statistically significant (p<0.001). In the fluorosis group, we observed eight cases (16%) of open angle glaucoma (OAG). Remarkably, the ICA HP grade was 4+ in six out of eight cases; this finding was statistically significant (p<0.001). The remaining two cases showed grade 1+ ICA HP. The difference between the number of cataracts or previous cataract operations in the two groups [fluorosis group: 15 cases (30%), controls: 12 cases (24%)] was not statistically significant (p>0.05). We suggest that heavy trabecular hyperpigmentation appearance may be a feature of endemic fluorosis. This disorder should be kept in mind in differential diagnosis of pathological trabecular hyperpigmentation in patients with and without fluorosis in relation to the causes and symptoms of iris pigment dispersion.

We also propose that endemic fluorosis may lead to or augment the severity of glaucoma. Further studies are warranted in order to comprehend the exact mechanism of trabecular changes in patients with endemic fluorosis.

Authors: Aytuluner E, Mensiz E.
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Keywords: Cataracts; Fluoride; Glaucoma; Trabecular hyperpigmentation.

**Cataractogenic effect of fluorosis in an animal model**

Endemic fluorosis is a chronic, crippling, skeletal, and dental disease caused by ingesting large amounts of fluoride either through water or less often from foods in endemic areas. Although systemic disorders of fluorosis have a wide variety of appearances, little attention has been given to the spectrum of lenticular findings. Thirty rats were given commercially available spring water either with 100 ppm fluoride (experimental group, n = 15 rats, 30 eyes) or 0.07 ppm fluoride (control group, n = 15 rats, 30 eyes) for 24 weeks. The examinations revealed various levels of opacifications and histopathological changes in 12 eyes of the high fluoride intake group, whereas none of the eyes were affected in the control group. Differences between groups were significant (p<0.05). The study demonstrates that fluoride is a potential cataractogenic agent. Hence, the authors believe that dilution of fluoride in tap waters in endemic areas is an important measure for ophthalmic health. It is suggested that ophthalmological examinations should be performed on patients with documented endemic dental and skeletal fluorosis.
Authors: Aytuluner E, Mensiz E, Candir O, Aydin S.
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Keywords: Cataracts; Fluoride-lenticular effects.

**Editor’s Note:** The association between fluoride and lenticular disturbances summarized in the foregoing two abstracts recalls earlier discoveries by Ionel Rapaport, who found a significant relationship not only between elevated fluoride in drinking water and senile cataracts\(^1\) but also between fluoride and a higher incidence of cataracts among adults afflicted with Down’s syndrome.\(^2-4\) The new experimental results of Aytuluner and co-workers demonstrating increased lenticular opacification in rats after drinking 100-ppm fluoride water for 24 weeks are obviously of considerable interest and clearly call for further studies. Moreover, effects of potential counter-cataractogenic agents such as increased intake of vitamins C and E in the presence of fluoride would also be worth investigating.

**REFERENCES**


**CORRECTIONS**


In reference 19, p. 249, the second author’s name is Rosebrough rather than Rosenbough.

In reference 21, p. 249, the first author’s name is Folch rather than Foleh.


We thank Prof NJ Chinoy for pointing out these errors.

**TYPESetting CHANGES**

We thank Elke Babiuk for her excellent work in typesetting Fluoride from 1999–2003. The Managing Editor, Bruce Spittle, is now typesetting the journal.