Comparison of Fluoride Concentrations in Urine of Korean Children Aged 3-6 Years between Living in Water-Fluoridation Area and in Non-Fluoridation Area

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Abstract

This study was conducted to compare the fluoride concentrations in urine of preschool children aged 3~6 years between residing in community water fluoridation area(Kwangju City) and non-fluoridation area(Sungnam City). The acid-diffusible fluoride in the urine and drinking water was isolated by the acid-diffusion technique and measured with a fluoride electrode. The mean daily fluoride excretion to urine of children residing in Kwangju and Sungnam were 1.27±0.75mgF^-/g creatinine and 0.87±0.47 mgF^-/g creatinine, respectively. It is concluded from this investigation that the F^- concentration in urine sample of kindergarten and drinking water of children living in Kwanju(fluoridated areas) were significantly higher than that of children living in Sungnam(non-fluoridated areas).

Introduction

The prevalence of dental caries in developed countries has declined over the past several decades, which considered mainly due to the widespread use of fluoride in variety method as well as the policy of community water fluoridation. On the other hand, trends of increased fluoride ingestion and a rise in enamel fluorosis have appeared in both fluoridated and non-fluoridated areas. Therefore, an accurate analysis of fluoride intake in children residing in fluoridated and non-fluoridated areas is important in that the level of fluoride necessary for adequate prevention of dental caries is only marginally less than that which can cause fluorosis. And It is necessary for making decision of efficiency of community water fluoridation that we determine the accurate amount of intakes of fluoride by analysis fluoride conc. in urine and drinking water of children residing in fluoridated area and non-fluoridated area.

Materials and Method

The two communities in this study from which urine and drinking water were collected were the fluoridated community of Kwangju and the non-fluoridated community of Sungnam, Kyunggido, Korea. These communities were selected because of their documented fluoride histories; their proximity to one another; and the similarity of their demographic and socioeconomic characteristics. 210 preschool children aged 3~6 were selected for collecting urine and drinking water.

Urine and drinking water samples were directly analyzed for fluoride using fluoride-ion specific electrode(Orion Research EA940). A 10-ml aliquot of each sample was mixed with equal volume of Total Ionic Strength Buffer(TISAB II) and placed directly under the electrode. The resulting millivolt readings were recorded and the fluoride concentration of each sample was calculated from a standard curve constructed on the basis of the millivolt readings for a series of fluoride standards analyzed at the same time, under the same conditions. The concentration of creatinine in urine was also analyzed.

The mean fluoride content, minimum and maximum values, standard deviation were determined for each urine and water samples, and fluoride concentration in urine was corrected by g creatinine level in urine. Student's t-test was used to test for differences between the two communities. A significance level of α=0.05 was used to test all hypotheses. Statistical analyses were performed using SPSS V12.0.

Results and Discussion

The data of fluoride concentration in urine and drinking water were obtained form 210 children with 115(57 boys, 58 girls) residing in Kwangju and 95(54 boys, 41 girls) in Sungnam. The children participated in this investigation were aged 59.87±12.89 months and weighted 18.19± 3.41 kg.

Table 1. Number of children by classification of fluoride concentration in drinking water

Classification of Concentration(mg/L)	Total number of children(%)	Number of children in Kwangju(%)	Number of children in Sungnam(%)
Lower(<0.3)	139(70.9)	53(51.0)	86(93.5)
Efficient(0 3~0.6)	15(7.7)	10(9.6)	5(5.4)
Appropriate(0.6~1)	41(20.9)	41(39.4)	0(0.0)
Higher(>1.5)	1(0.5)	0(0.0)	1(1.1)
Total	196(100.0)	104(100.0)	92(100.0)

* average fluoride concentration of drinking water : Kwangju 0.38±0.31mg/L, Sungnam 0.14±0.25mg/L

Half of the number of drinking water at fluoridated area were lower F^- concentration than that of sufficient for preventing dental caries(0.3 mg/L). And most of drinking water at non-fluoridated area were lower than that concentration(0.3 mg/L) except one outlier.

The mean fluoride concentration in urine of children aged 3~6 in this research are shown in table 2. The mean fluoride concentration as the children's living area were 1.27±0.75 mgF^-/g

creatinine to Kwangju and 0.87±0.47 mgF⁻/g creatinine to Sungnam at the kindergarten sample. As would be expected, the fluoride concentration in urine of children living in fluoridated area was significantly higher than that of children living in non- fluoridated area ($p<0.001$) determined by t-test. But the fluoride concentration in urine of home samples were not significantly different between the two groups(Table 2).

Table 2. Fluoride concentration in urine of Korean children

Urine Classification	Total(N=210) (mgF⁻/g creatinine)	Kwangju(N=115) (mgF⁻/g creatinine)	Sungnam(N=95) (mgF⁻/g creatinine)	p-value
Home[a]	1.32±2.55[a]	1.50±1.99	1.11±3.09	0.287
Kindergarten[b]	1.09±0.67	1.27±0.75	0.87±0.47	0.000

[a]Urine sample gathered before going to bed at night
[b]Urine sample gathered at daytime in the kindergarten

It is because that tap-water was used as drinking water in the kindergarten, but about half of the children didn't drink tap-water at home.

Conclusion

This study was conducted to determine the fluoride concentration in urine of Korean children aged 3~6 years living in the fluoridated area and non-fluoridated area. We adopted fluoride-specific electrode to analyze the amount of fluoride in children's urine. Half of the number of drinking water at fluoridated area were lower F^- concentration than that of sufficient for preventing dental caries and most of drinking water at non-fluoridated area.

The mean fluoride concentration in kindergarten urine sample of children residing in Kwangju and Sungnam were 1.27±0.75 and 0.87±0.47 mgF⁻/g creatinine, respectively. In this research, we observed similar results compared to that of previous investigators in Korea and other country. It is concluded from this investigation that the amount of fluoride excreted by urine of children was important biological marker of exposure(intake) to fluoride. And children living in Kwangju(fluoridated areas) did not exceed the upper intake F^- level to avoid the risk of dental fluorosis.

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