

Evaluation of Required Fluoride Levels in Hard Dental Tissues Through the Monitorisation of Renal Excretions

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Improper administration of fluoride can result in overdosing it with the occurrence of dental fluorosis and its accumulation in other tissues or systems. The aim of this study is to evaluate the importance of fluoride intake by assessing fluoride urinary excretion before to decide administration of fluoride supplements for cariostatic effect of them. In this study, was collected and measured the fluoride levels in 16 h urine samples in order to evaluate fluoride excretion rates in a 32 children group divided equally 16 children receiving fluoride supplements at the time of the study and, 16 who were not receiving. The results obtained in this study reveal that both daily fluoride excretion as well, estimated daily fluoride dose are well below to the reference values considered to be normal for an optimal fluoride administration to the children who do not receive fluoride supplements. On the other in children who receive fluoride supplements the total daily fluoride excretion values are located at the upper limit and estimated daily fluoride dose above the upper limit. As a result, we consider that before fluoride supplementation it is necessary to perform some analysis to show which is the daily fluoride intake.

Keywords: fluoride levels, fluoride supplements, daily fluoride dose

Fluoride is accepted as an effective method to prevent caries worldwide [1].

The beneficial effect of fluoride can be obtained by systemic administration well as by topical application. Fluoride cariostatic effect administrated by local application is scientifically proven while its beneficial effect obtained by systemic administration has been not clarified yet [2]. Improper administration of fluoride can result in overdosing it with the occurrence of dental fluorosis and its accumulation in other tissues or systems. Dental fluorosis occurs as a result of a fluoride overdose during tooth formation, so in childhood [3]. The safe level for daily fluoride intake is 0.05 to 0.07 mg F/Kg/day. Above this level, the risk of developing fluorosis due to chronic fluoride consumption will be evident [4, 5]. In order to prevent adverse impacts of fluoride, it is important to identify fluoride sources to which children are subjected by analyzing various biomarkers of fluoride intake [6].

From total fluoride ingestion, only a small part is absorbed. Renal excretion is the predominant route for the removal of inorganic fluoride from the body [1]. In 24 h approximately 35-50 percent of fluoride absorbed by the healthy young and middle age adult is assimilated by hard tissue [1, 7 - 10]. Because in growth period absorption rate is higher in children urinary fluoride excretion is smaller, approximately 45 percent. Taking into account this, the determination of urinary excretion is an effective method

for assessing the fluoride intake, in addition to its determination in saliva and plasma [6, 11].

The aim of this study is to evaluate the importance of fluoride intake by assessing fluoride urinary excretion before to decide administration of fluoride supplements for cariostatic effect of them.

Experimental part

Material and method

In this study, was involved 32 children from Targu Mures with age range between 6 and 7 years. The Ethics Committees of the University of Medicine and Pharmacy of Targu Mures approved the study and the parents of children involved in the study signed the appropriate consent form.

The group study was divided equally 16 children receiving fluoride supplements at the time of the study and, 16 who were not receiving. Parents did not specify the presence of any general diseases.

In this study, was collected and measured the fluoride levels in 16 h urine samples in order to evaluate fluoride excretion rates, according WHO recommendation published in 1999 [11]. The urine samples were collected in two time periods by persons trained in this regard (parents, kindergarten staff).

Time I – period spent by children in kindergarten, from 8 to 16 o'clock. Previously parents noted last emission of

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24 Urinary Fluoride excretion (µg)	Lower	Upper
Age 3-5y Low F intake Optimal F usage	170 360	290 480
Age 6-7 y Low F intake Optimal F usage	190 480	310 600
Age 10-14y Low F intake Optimal F usage	220 600	340 820

Table 1
PROVISIONAL STANDARDS RECOMMENDED BY WHO (1999)
FOR 24-h URINARY FLUORIDE EXCRETION OF DIFFERENT
AGE GROUPS

24 Urinary fluoride excretion (µg)	children who receive fluoride supplements (694.48±210.30)	children who don't receive fluoride supplements (258.23±103.43)
*Low F intake Lower 190 Upper 310	P < 0.0001 P < 0.0001	P=0.0186 P=0.0637
*Optimal F usage Lower 480 Upper 600	P=0.0010 P=0.0925	p< 0.0001 p< 0.0001

*optimal values

Table 2
URINARY FLUORIDE EXCRETION IN
STUDY GROUPS COMPARED WITH
OPTIMAL VALUES

estimated daily F dose µg F/Kg/day	children who receive fluoride supplements 98.464±28.496	children who don't receive fluoride supplements 38.012±15.420
*Lower 50	p< 0.0001	P=0.0072
*Upper 70	P=0.0012	p< 0.0001

*optimal values

Table 3
ESTIMATED DAILY FLUORIDE DOSE IN
STUDY GROUPS COMPARED WITH
OPTIMAL VALUES

urine without collected that. Each micturition was collected in separate labeled plastic bottles.

Time II – nocturnal period. Each parent involved in the study recorded in the evening before bedtime, the hour of the last emptying of the bladder without collecting the urine. In a labeled plastic bottle, was collected the first micturition of the morning.

On the label of the bottle was recorded, for both sample the following data: name, age, gender, weight, hour of first and last urine collection and urinary volume for each child involved in this study.

Fluoride urinary concentration was evaluated by using potentiometric method with an Orion 720A potentiometer equipped with fluoride specific electrode (ORION 9409) after the addition of TISAB II at a ratio of 1:1.

Rate of fluoride excretion during the diurnal period (period spent by children in kindergarten) and nocturnal period, estimated amount of fluoride excreted in the period in which was not collected urine and 24 hours estimated urinary fluoride excretion was calculated. Fluoride intake can be estimated considering the fractional urinary fluoride excretion constant at 0.35, according to equation proposed by Villa [12]: fluoride intake (µgF/kg/day)=fluoride excretion in 24 h/0.35/weight.

For comparing the data, obtained it was taken as reference standards set by WHO for urinary fluoride excretion of 3-14-year-old children receiving low and or optimum fluoride (table 1).

Study data were collected using Microsoft Excel and analyzed with NCSS/PASS Dawson Edition. Mann-Whitney and One sample t test were used, statistical significance was set at p < 0.05.

Results and discussions

In children who receive fluoride supplements the mean of fluoride excretion rate during the diurnal period (µg/h) was 31.370±11.461 and 25.530±11.765 for nocturnal period (no statistical difference p= 0.2871) and in those who do not use fluoride supplements 11.499±6.656

respectively 9.724±5.010 (no statistical difference p= 0.7520). With an extremely significant difference between them (p< 0.0001) the mean of the total daily fluoride excretion µgF/day in children who and don't receive fluoride supplements was 694.48±210.30 (minimum 322.77, maximum 1136.5) and 258.23±103.43 (minimum 107.64, maximum 413.73). Was found an extremely significant difference (p< 0.0001) between the mean values 98.464±28.496 (minimum 47.952, maximum 162.74), 38.012±15.420 (minimum 16.625, maximum 64.034) of estimated daily F dose in children who and don't receive fluoride supplements. In table 2 are presented the results of the comparison between means values of total daily fluoride excretion, recorded in this study with those considered optimal for the age group studied.

The result obtained by comparing the mean values of estimated daily fluoride intake with optimal values are presented in table 3.

The results obtained in this study reveal that both daily fluoride excretion as well-estimated daily fluoride dose are well below to the reference values considered to be normal for an optimal fluoride administration to the children who do not receive fluoride supplements. On the other, in children who receive fluoride supplements the total daily fluoride excretion values are located at the upper limit and estimated daily fluoride dose above the upper limit. The result obtained in the present study are similar to those recorded by Szekely et al. in two studies conducted in 2005 and 2008 on groups of children from Tirgu Mures. In that studies, were used two different methods for assessing urinary fluoride excretion. For the first study was used one urinary sample being calculated ratio fluoride/creatinine and for the second the method was used 16-h time-controlled urine sampling and the obtained results reveals low fluoride intake in pre-school children [13, 14]. Same result was obtained by Baez et al. in a study performed on a group of children from Timisoara and Bucharest [15].

At 4-6 years old children from a South Texas community that had concentrations of fluoride in drinking water

supplies generally around the optimal level (1-1,3 ppmF), urinary fluoride excretion was 0,749 ppm F [16]. On a study group of children with age between 4 and 5 years with normal diet, regular tooth brushing with fluoridate toothpaste and drinking fluoridate milk during time spent at kindergarten, Ketley et al. reveal a 0,33 ppm urinary fluoride concentration [17]. Several authors suggest that high level of the estimated fluoride intake in condition of a normal diet, without fluoride supplements and regular use of fluoridate toothpaste is due ingestion of fluoridate toothpaste [18, 19]. On the other hands, many studies suggest that the high level of fluoride in urine are not correlated with use of fluoridate toothpaste but with drinking fluoridate water [20].

Conclusions

Assessment of urinary fluoride excretion is an effective method for monitoring fluoride intake, but it is laborious and requires cooperation from parents, school staff, and children.

We consider that before fluoride supplementation it is necessary to perform some analysis to show which is the daily fluoride intake because in this study was observed that in group of children who received fluoride supplements some have very high level of urinary fluoride concentration, above optimal.

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