Caries index, systemic fluoride supplementation and oral hygiene: Statistical analysis in a sample of pediatric subjects

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KEYWORDS
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ABSTRACT
Aim This study is a statistical retrospective analysis on the correlation between intake of systemic fluoride, oral hygiene conditions and frequency of dental caries in primary and permanent dentitions in a sample of pediatric subjects. The aim of our study was to evaluate in a sample of patients how the caries index (dmft and DMFT) could vary according to the assumption of systemic fluoride supplements, the oral hygiene condition (measured with the Oral Hygiene Index - OHI-S) and the age of the first pediatric dentistry visit.

Materials and methods The study is based on the analysis of a sample of 1000 subjects (500 males and 500 females), aged between 3 and 14 years old (mean 9.3) conducted in the division of Pediatric Dentistry at the University of Rome Tor Vergata.

Results Caries frequency in primary teeth is not significantly influenced by patient gender, fluoride intake and duration of fluoride intake; it is significantly influenced by the age of the first pediatric dentistry visit (p<0.001) and Oral Hygiene Index (p<0.001). Caries frequency in permanent teeth is not significantly influenced by patient gender (p>0.1), duration of fluoride intake (p>0.1), it is significantly influenced by age of the first pediatric dentistry visit (p<0.001) and Oral Hygiene Index (p<0.001). We found a positive correlation between number of deciduous teeth decayed and permanent teeth decayed (p<0.0001).

Conclusion This study does not support the hypothesis that systemic fluoride intake may reduce the prevalence of caries in deciduous and permanent teeth. A high Oral Hygiene Index and early age of the first pediatric dental examination seem to have a positive effect on reducing the prevalence of tooth decay.

Introduction
Anthropological studies have demonstrated that dental caries have always been present in humanity (1, 2); however, its prevalence evolved through years being influenced by two main factors: the presence of refined carbohydrates and the discovery of the preventive properties of fluoride (3).

The presence of dental caries dramatically decreased in industrialized countries over the last decades; at the same time there has been a considerable increase of caries free subjects (2, 3). The spread on large scale of fluoride was the main cause of this trend starting from the 70s. The proliferation of dental caries is mainly spotted during the pediatric age and especially among low-income families (4).

Even though there have been dramatic improvements in terms of general health, the incidence of dental systematic diseases in pediatric age remains relatively high (5). Despite the decrease in dental caries prevalence over the last decades, the presence of dental caries in Italy resulted to be a constant issue, especially in pediatric subjects, at such a level that all children have to be considered at risk in terms of caries.

The most recent national study in Italy regarding the prevalence of dental caries in the country was carried on in 2006 (6, 7). These data highlight a caries disease prevalence of 22% at 4 years of age, and almost 44% at 12 years of age.

Fluoride today is considered to be one of the most effective means for the prevention and prophylaxis of dental caries on both topical and systemic level.

While there is a scientific evidence that topical fluoride administration prevents dental caries, it is still unclear the effective role of systemic fluoridation with regards to the decrease of dental caries incidence.

The main sources of fluoride supply can be divided in: natural and non-natural; where natural sources are considered to be the components of the ambient (such as water, food, air) which bring fluorides to the human
being. Non-natural sources are mainly represented by pharmaceutical products, fluoride based, which have a topical application such as: toothpaste, mouthwash, varnishes and fluoride based gels.

Fluoride on a systemic level is mainly absorbed at the gastrointestinal tract and then distributed to soft tissues, hard tissues and to various body fluids such as saliva, tears, cerebrospinal fluid and plasma. Most of fluorides present in the human body are condensed in calcified tissues. Such affinity results in a relation between the amount of fluoride taken with drinkable water and their concentration in hard tissues.

Fluoride interacts with the structure of the tooth (enamel) both during the period of ontogenesis and after its complete development in the oral cavity. The consumption of fluoride in a systemic way, during the ontogenesis, allows the deposition of that mineral in the deepest layers of the developing enamel; this affects the development of fluorapatite crystals, which are more soluble than hydroxyapatite and more resistant in terms of attacks from plaque’s acids, more stable since it is composed by a smaller molecule.

The aim of this study was to analyze if the consumption of fluoride on a systemic level results in an actual benefit for the reduction of dental caries. We have conducted the study based on a statistical retrospective analysis with a sample of pediatric subjects conducted in the division of Pediatric Dentistry at the University of Rome Tor Vergata.

The aim of our study was to evaluate, through the analysis of a sample of patients, how the caries index (dmft and DMFT) could vary according to the assumption of systemic fluoride supplements and the oral hygiene condition of each subject.

The study is based on an analysis of a sample of 1000 subjects, aged between 3 and 14 years (average 9.3 years). We selected 500 male patients and 500 female patients, through the simple random sampling method among the patients referred to the service of Pediatric Dentistry at the University of Rome Tor Vergata in the period from January 2005 to October 2015.

Patients with systemic diseases linked to high risk factors for caries (diabetes, celiac disease) were excluded from the sample.

We have taken into consideration the following data: age, gender, systemic diseases, fluoride intake, duration of fluoride intake, dmft/DMFT index and Oral Hygiene Index (OHI-S). Oral hygiene was recorded as good, sufficient or poor according to the Simplified Oral Hygiene Index.

Data were computerized and statistically analyzed through the Generalized Linear Model (GLZ) and the chi-square test for two independent samples in order to obtain percentages and absolute frequencies, putting into relation the two sets of data so to verify and highlight any significant correlation.

Results
The results show that 32% of the examined subjects referred systemic fluoride supplementation, with different and not standardized modalities, while 68% never used supplements of fluoride.

Considering the group of subjects who received systemic fluoride supplementation, everyone began its administration within the first year of life and then continued for a period ranging between 6 months and 12 years of age (Figure 1).
Caries indexes of the two groups, for deciduous teeth (dmft) and the permanent teeth (DMFT), are indicated in Figures 2 and 3.

With regards to the data obtained for the Oral Hygiene Index (OHI-S) in our sample, the results are shown in Figure 4.

Caries frequency in primary teeth is not significantly influenced by: patient gender (p>0.5), systemic fluoride intake (p>0.8), duration of fluoride supplementation intake (p>0.5), it is, however, significantly influenced by age of the first pediatric dentistry visit (p<0.001) and Oral Hygiene Index (p<0.001).

Figure 5 shows the relationship between "probability of caries in deciduous teeth" and "age of the patients at the first pediatric dentistry visit"; while Figure 6 analyzes the relationship between "probability of caries in deciduous teeth" and "Oral Hygiene Index". These figures highlight how a late first pediatric dental visit and poor oral hygiene positively affect on probability of caries in deciduous teeth.

Caries frequency in permanent teeth is not significantly influenced by patient gender (p>0.1),
duration of fluoride intake \((p>0.1)\), but it is significantly influenced by age of the first pediatric dentistry visit \((p<0.001)\) and Oral Hygiene Index \((p<0.001)\).

Figure 7 shows the relationship between “probability of caries in permanent teeth” and “age of the patients at the first pediatric dental visit”; while Figure 8 analyzes the relationship between “probability of caries in permanent teeth” and “Oral Hygiene Index”. These figures highlight how a late first pediatric dental visit and poor oral hygiene positively affect on probability of caries in permanent teeth.

We found a positive correlation between number of decayed deciduous teeth and decayed permanent teeth \((p<0.0001)\). This correlation is shown in Figure 9 and suggests a tendency for patients with caries in deciduous teeth to develop caries also in permanent teeth.

**Discussion**

The results of the study do not support the hypothesis that systemic fluoride supplementation, taken as prevention, will decrease the frequency of dental caries in both deciduous and permanent teeth. In fact, the probability of dental caries is not significantly influenced by the consumption of fluoride in both deciduous teeth decayed \((p>0.8)\) and permanent teeth decayed \((p>0.1)\).

There is nowadays a scientific evidence that topical fluoride has a post-eruptive effect in addition to the pre-eruptive one that has already been studied and confirmed \((5)\).

Moreover, the correlation between the decrease of dental caries prevalence in our industrialized society and the vast consumption of fluoride toothpaste, brings to reconsider the way fluoride acts, moving the attention to its post-eruptive efficacy \((3, 10)\).

Up to now, the post-eruptive preventive effect of fluoride, due to a topical administration, is considered to be much more effective than the pre-eruptive one which is mostly resulting from a systemic consumption \((11, 12)\).

It would be now relevant to underline that the decline of dental caries prevalence, in industrialized countries is mostly attributed to the increasing spread of fluoride toothpastes \((13, 14)\). Consequently, fluoride toothpaste represents a primary way of administration for the prevention of dental caries \((11, 15, 16, 17)\). In fact, fluoride’s caries preventive properties are mainly given by a topical post-eruptive action. It is indeed confirmed that such mineral, in order to implement its efficacy, needs to: be present in the interface between enamel and bacterial biofilm, and remain in situ during an acid attack in a quantity of 0.01-0.04 ppm \((13, 18)\).

This attitude does not mean that fluoride incorporated into the enamel does not reduce amount of dissolution, however, this factor by itself is not enough in order to explain the decrease of dental caries \((39)\).

In accordance with the Italian National Guidelines, topical fluoridation might be suggested from 6 months to 6 years of age through the use of a toothpaste containing a fluoride level of at least 1000 ppm, twice a day, in a pea-size dose. After the first six years, fluoridation is done through the use of a toothpaste containing a fluoride level of at least 1000 ppm, twice a day \((5)\). However, there are still many debates about fluoride’s pre-eruptive efficacy and the scientific evidence regarding the efficacy of systemic fluoridation is controversial \((5, 11)\).

Moreover, it is not simple to distinguish fluoride pre-eruptive and post-eruptive effects when analyzing the results of clinical and epidemiological studies. In fact, it is not possible to make randomized and controlled studies on either fluoride supplements or fluoridated water in order to determine the actual anti-caries efficacy obtained from pre or post-eruptive effects; in addition, once the tooth has erupted there is a
cumulative effect with topical fluoridated products (11).

Fluoride pills or drops usually containing sodium fluoride, have been released with the intent of giving fluoride supplements necessary in areas where water fluoride is not present in sufficient quantities. It has been suggested to use them also during pregnancy; however, the efficacy of preventing the unborn child to suffer of dental caries has not been proven yet, also because the presence of fluoride for 0.4 ppm in maternal blood seems to be such a level that the placenta activates the barrier in order to avoid the passage of fluoride itself (19). In addition, the chances of fluorosis at a dental level, suggests, in the USA, not to supplement fluoride during pregnancy (20).

Several studies (21, 22, 23) have critically analyzed past literature in order to determine the efficacy of fluoride supplements for caries prevention.

Since the end of the 90’s the consumption of fluoride supplements, for the prevention of caries, has been reconsidered in several countries. Recommendations regarding their consumption were modified; dosages suggested for several age groups have been reduced and the administration of supplements has been limited exclusively to children at high risk (5, 24, 25).

Recommendations for fluoride supplements consumption are different country by country; in fact, indications and modalities/methods often are not univocal for public dental health services and among dentists (26, 27, 28, 29).

The most statistically relevant result found in this study is the positive effect of the Oral Hygiene Index on the presence of caries on both deciduous (p<0.001) and permanent teeth (p<0.001), in addition to the significant positive correlation between decayed deciduous teeth and decayed permanent teeth (p<0.0001).

In conclusion, in order to offer an effective intervention with regard to the promotion of oral hygiene and health, it is vitally relevant to inform parents and their children about the importance of preserving the integrity of deciduous teeth and without dental caries by attending pediatric dentistry visits in the early ages.

References