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Effect of Preventive Oral Hygiene Measures on the Development of New Carious lesions

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Purpose: To evaluate the effect of preventive oral hygiene measures on the development of new carious lesions.

Materials and Methods: Children regularly and irregularly attending recall appointments in a paediatric dental clinic were interviewed regarding their preventive measures performance. Newly developed carious lesions were also recorded. The files of 651 children were analysed.

Results: A significant negative correlation was found between newly developed carious lesions and total number ($P < 0.001$) and frequency (interval in months to the next dental examination) of recall appointments ($P = 0.021$), regular toothbrushing twice a day ($P < 0.0001$), regular brushing in the evening ($P < 0.001$), high fluoride concentration in toothpaste ($P < 0.0001$) and drinking water between meals ($P = 0.015$), but not with regular brushing in the morning or eating more than 6 times a day. Multivariate analysis revealed three of the variables independently correlated with the development of new carious lesions: brushing regularly twice a day, concentration of fluoride in the toothpaste greater than 1100 ppm and frequency of follow-ups.

Conclusions: Regular toothbrushing twice a day is of high importance for caries prevention. Fluoride concentration of > 1100 ppm in toothpaste should be recommended for children (considering the child's age) in order to maximise the fluoride protective effect. The importance of attending periodic recall appointments in order to maintain long term oral health should be emphasised.

Key words: children, compliance, DMF, floss, fluoride, recall-appointments, toothpaste

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An important component in the maintenance of dental health and reducing individual dental risk is the meticulous practice of several daily home preventive measures (AAPD, 2010). These include avoiding frequent consumption of carbohydrates (sugary drinks and food) between meals and toothbrushing twice a day with fluoridated dentifrices (Dijkman et al, 1990). No conclusive evidence is available for the effectiveness of flossing once a day (Sambunjak et al, 2011). For moderate- to high-caries risk children, rinsing with fluoride mouthwash and/or brushing with a high concentration of fluoride gel (12,500 ppm fluoride ions) once a week are also recommended. These home preventive measures are defined as 'dental home' (AAPD, 2010).

The rationale for these recommendations is that frequent consumption of fermentable carbohydrates including sugary drinks (more than 6 per day) is associated with increased demineralisation of tooth substance, decreased remineralisation and increased caries experience (Bowen et al, 1983; Zaura and ten Cate 2004; Dong et al, 1999). The duration of demineralisation following fermentable carbohydrate consumption depends on the age of the accumulated plaque. In teeth without plaque accumulation, the duration is limited to about 30 min. However, in old plaque (several days) the decrease in pH may continue for several hours (Dong et al, 1999). Therefore, to prevent accumulation of old pathogenic plaque, brushing at least twice a day is recommended. Parents with young children who lack the ability to effectively brush their teeth should brush their children's teeth.

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Fluoridated toothpaste is recommended to enhance the remineralisation process induced by saliva (Bowen et al, 1983; Zaura and ten Cate 2004).

Topical fluoride products were shown to decrease caries development by 30% while systemic fluoride was shown to do so by 40% to 60% (Petersson et al, 2004). The mechanism of action of topical fluoride products depends on the fluoride concentration. At low concentrations (as in toothpaste, oral rinse), the fluoride mainly increases the remineralisation of demineralised lesions (Deng et al, 2005). However, at higher concentrations (such as in Elmex fluoride gel [GABA; Lörrach, Germany], topical application of fluoride gel at the dental office), the fluoride also inhibits the bacterial adherence to the enamel surface, inhibits the bacterial enzymatic activity or destroys the cariogenic bacteria (Davies et al, 2003).

Another important component of prevention includes compliance of patients in attending periodic recall appointments. During these appointments, the dentist enhances caries prevention by 1. application of high concentrations of fluoride as gel; 2. application of fissure sealants on newly erupted teeth; 3. reinforcement of the child's compliance with various components of 'dental home' preventive measures (AAPD, 2010).

In spite of the prime importance of daily home preventive measures, only a few studies have evaluated the effect of those factors on newly developed carious lesions, with conflicting results (Jones et al, 1996; Eckersley and Blinkhorn 2001; Lee et al, 2002; Levin and Shenkman 2004; Ashkenazi et al, 2007). The aims of the present study were therefore twofold: to evaluate the effect of preventive oral hygiene measures on the development of new carious lesions and to evaluate the effect of attending periodic recall appointments on the development of new carious lesions.

MATERIALS AND METHODS

Children aged 2 to 18 years who attended regular and irregular recall appointments at a specialised paediatric dentist's clinic in Petach-Tikva, Israel, from 2002 to 2008, participated in the study. This clinic treats patients from all socioeconomic levels due to referral of uncooperative children. Only children who attended at least one consecutive recall after completion of required treatment at the previous examination were included. All participants and/or their parents received a comprehensive, structured lecture regarding the various preventive measures at the first visit by one paediatric dentist (MA). Following clinical and radiographic examination, they received instructions regarding the various preventive measures the child needed to practice until the next periodic examination. At each recall appointment, children and their parents were interviewed by the same paediatric dentist regarding the present status of the child's compliance with the previously recommended preventive measures. In the case of complete compliance, the patient was reinforced, while in the case of noncompliance, the patient and/or his parents received further information regarding the importance of compliance with the recommended preventive measures. Interviews were completed before the clinical examinations.

A structured form was designed to collect demographic data, such as patient's age and gender, date of recall appointments and child's preventive measures practice.

Newly diagnosed carious lesions at the last examination were recorded and treated. Caries examination was performed clinically and radiographically by the same paediatric dentist (MA).

Preventive measures evaluation

- Frequency of attending periodic recall appointments: The routine of the practice was to remind the patient after 6 months to attend periodic examination. Each recall appointment included diagnosis of new carious lesions, fissure sealants when indicated and fluoride application.
- Frequency of meals: The patients and/or their parents were asked whether they usually ate more or less than 6 meals a day, not including soft drinks.
- Drinking between meals: Patients were interviewed about their drinking habits only between meals. Patients were categorised into three groups: drinking only water or diet (carbonated or non-carbonated) beverages, drinking sugary noncarbonated beverages alone or alternately with water, drinking sugary carbonated beverages alone or alternately with water.
- Brushing twice a day: Children were asked whether they brushed their teeth in the morning and in the evening. If yes, they were asked how many days a week they brushed their teeth.
- Use of fluoridated toothpaste: For children up to 4 years old, the recommended fluoride-ion con-

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centration was limited to 500 ppm F^-, for children aged 4 to 7 years, the recommended fluoride-ion concentration was 1000 ppm F^-, and over the age of 7 years, parents were instructed to use adult toothpaste (1200–1450 ppm F^-) for their children (Eckersley and Blinkhorn, 2001). Oral instructions were given to parents on how to verify the F^- concentration in toothpaste together with a written list of several toothpastes with their fluoride concentration.

- Use of daily fluoride mouth rinse: Children diagnosed as medium- to high-risk for caries development according to the AAPD guidelines were recommended to rinse their mouth daily with fluoride mouthrinse. To increase compliance, children were given a taste of several commercial fluoride rinses, told to choose one they preferred with the best taste and to use it. Self-reported compliance of these children with performing the daily rinses was evaluated and recorded as days per week (0 to 7) at the next appointment.
- Use of high-concentrate fluoride gel: Children diagnosed as medium to high risk for caries development according to the AAPD guidelines were recommended to brush their teeth once a week with high-concentrate fluoride gel (Elmex, GABA; Lörrach, Germany), which contains 12,500 ppm F^-. Self-reported compliance of these children with using Elmex gel was evaluated and recorded as number of weeks per month (0 to 4) at the next appointment.
- Flossing: Children over the age of 11 years without fixed orthodontic appliances were instructed to floss their teeth once a day. Their performance was evaluated and recorded as days per week (0 to 7) at the next appointment.
- The Ethics Committee of Tel Aviv University approved the study.

Statistical analysis

Data were analysed by SPSS 10.0 (SPSS; Chicago, IL, USA) using the t-test, chi-square test, nonparametric correlations (Spearman's rho coefficient) and one-way and two-way ANOVA. The level of significance was set at 5%.

RESULTS

Study population

The files of 651 children (53% girls, 47% boys) who attended recall appointments in a private clinic of one certified paediatric dentist were analysed. The mean age was 9.36 ± 4.38 years. Children attended 3.39 ± 2.53 recall visits on average (range 1–15) every 12.32 ± 5.98 months. Older children were found to visit the clinic more frequently ($P < 0.001$).

Number and frequency of periodic recalls

A significant negative correlation was found between the total number of periodic recalls and the total number of newly developed carious lesions ($P < 0.001$), occlusal carious lesions ($P < 0.0001$), smooth-surface carious lesions ($P < 0.001$) and teeth requiring crown/extraction ($P < 0.0001$). Similarly, a negative correlation was found between the frequency of periodic appointments and the total number of newly developed carious lesions ($P = 0.021$) and smooth-surfaces carious lesions ($P = 0.005$).

Eating regular meals

Eating 6 or fewer times a day was reported by 77.9% of the children and 22.1% reported eating more than 6 times a day (snacks between meals). Eating more than 6 meals a day was not found to be related to newly developed carious lesions.

Types of consumed water at home

Of the children, 62.5% reported drinking only tap water (most of the country is fluoridated), 34.7% reported drinking bottled water (all bottled water lacks fluoride supplementation), 1.7% reported drinking tap and bottled water alternately and 1.1% of the children drank tap water after filtration with inverted osmosis.

Children who reported drinking tap water had 38.89% less new carious lesions (smooth surface and occlusal) as compared to children who reported drinking only bottled water (0.77 ± 1.79 vs 1.26 ± 2.42, $P = 0.028$).

Types of consumed drinks between meals (Table 1)

Drinking only water or sugarless beverages between meals was reported by 59.3% and 3.9% of

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the children, respectively. Drinking water and sugary drinks (carbonated or not carbonated) alternately was reported by 30.6% and 6.2% did not drink water at all between meals. Of the studied population, 13.8% reported drinking sugary carbonated beverages between meals.

A significant positive relation was found between drinking sugary drinks between meals and newly developed carious lesions (Table 1). Similarly, children who reported drinking only water between meals had significantly fewer new carious lesions.

Frequency of toothbrushing

A high percentage of children brushed their teeth at least once a day (89.9%). Brushing teeth twice a day was reported by 53.9% of the patients. Toothbrushing seven days a week in the morning was reported by 73.4% children and 65.9% brushed in the evening. Only seven children (1.1%) did not brush their teeth at all. No statistical difference was found in the frequency of toothbrushing in the evening among children of different age groups.

Children who brushed their teeth 0–5 times a week, 6–9 times a week and 10–14 times a week had a mean of 1.00 ± 1.44, 1.16 ± 2.08 and 0.82 ± 1.94 new carious lesions, respectively. A significant negative correlation was found between the total number of toothbrushings a week and the total number of new carious lesions ($P < 0.0001$), smooth-surface carious lesions ($P = 0.011$), occlusal carious lesions ($P = 0.003$) and teeth needing crown restoration or extraction ($P = 0.003$). Similarly, a significant negative correlation was found between the total number of toothbrushing in the evening and the total number of new carious lesions ($P < 0.001$), smooth-surface carious lesions ($P = 0.022$), occlusal caries ($P < 0.001$) and teeth needing crown restoration or extraction ($P = 0.007$). In contrast, no such relation was found between the total number of toothbrushings in the morning and any parameter of caries development except teeth needing extraction or crown restoration.

Interestingly, a positive correlation was found between the number of follow-ups and number of toothbrushings a week ($P < 0.0001$), number of toothbrushings in the morning ($P < 0.0001$) and in the evening ($P = 0.002$).

Who brushes the child's teeth (Tables 2 and 3)

The distribution of children according to who brushed their teeth is presented in Table 2. A significant relationship was found between who brushed the child's teeth and the number of newly developed occlusal carious lesions (Table 3). The mean number of newly developed of occlusal lesions was the highest when the toothbrushing was performed alternately by the child and by their parents ($P = 0.004$). Children who brushed their teeth 10–14 vs 0–9 times a week had significantly fewer newly developed carious lesions no matter who brushed their teeth ($P = 0.047$).

Fluoride concentration in the toothpaste (Tables 4 and 5)

The distribution of children according to their age and concentration of fluoride in their toothpaste is described in Table 4. Low fluoride concentration in the toothpaste was related to a higher number of

Table 1 Distribution of teeth with different types of new carious lesions according to drinking sugary drinks between meals

Type of carious lesions	Drinking sugary drinks between meals	Incident caries	*P*-value
Any	Yes	76/199 (38.2%)	0.002
	No	94/369 (25.5%)	
Occlusal	Yes	42/199 (21.1%)	0.01
	No	48/369 (13.0%)	
Smooth surfaces	Yes	44/199 (22.1%)	0.07
	No	59/369 (16.0%)	
Requiring crown/ extraction	Yes	21/178 (10.6%)	0.123
	No	24/369 (6.5%)	

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newly developed carious lesions (Table 5). No relation was found between teeth requiring a crown/extraction and concentration of fluoride in the toothpaste ($P = 0.221$).

Flossing

Of the children instructed to floss their teeth once a day, 78% flossed a maximum of once a week, 7% flossed 2–4 days a week and 15% flossed 5–7 days a week. Regularly flossing was not found to be related to the development of new carious lesions ($P = 0.16$).

Mouth rinsing

Of the children instructed to use a fluoride mouth rinse, 77% reported rinsing a maximum of once a week, 6% rinsed 2–4 days a week and 17% rinsed 5–7 days a week. Regularly rinsing was not found

Table 2 Distribution of children by who regularly brushed their teeth

	Who brushed the child's teeth			
Age	**Parent**	**Child**	**Child and parent alternately**	**Total**
0–4	45 (75%)	8 (13.3%)	7 (11.7%)	60 (100%)
4–7	83 (45.9%)	54 (29.8%)	44 (24.3%)	181 (100%)
>7	11 (2.7%)	375 (91.5%)	24 (5.8%)	410 (100%)
Total	139 (21.4%)	437 (67.1%)	75 (11.5%)	651 (100%)

Table 3 Distribution of new carious lesions according to who brushed the child's teeth

Type of caries	Who brushed the child's teeth	Incident caries	*P*-value
Occlusal	Parent	17/124 (13.7%)	0.004
	Child	51/380 (13.4%)	
	Child and parent	18/56 (32.1%)	
Smooth surface	Parent	66/380(17.4%)	0.561
	Child	21/124 (16.9%)	
	Child and parent	13/56 (23.2%)	
Requiring crown/extraction	Parent	12/124 (9.7%)	0.555
	Child	28/380 (7.4%)	
	Child and parent	3/56 (5.4%)	
Total	Parents	32/124 (25.8%	0.193
	Child	111/380 (29.2%)	
	Child and parent	22/56 (39.3%)	

Table 4 Number (%) of children by age using different concentrations of fluoride (ppm F^-) in their toothpaste

	ppm F^-			
Age	**> 500**	**500–1100**	**1200–1450**	**Total**
0–4	24 (46.25)	12 (23.15)	16 (30.8)	52 (100)
4–7	38 (22.6)	105 (62.5)	25 (14.9)	168 (100)
>7	18 (4.5)	35 (8.8)	347 (86.8)	400 (100)
Total	80 (12.9)	152 (24.5)	388 (62.6)	620 (100)

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to be related to the development of new carious lesions ($P = 0.51$).

Use of high-concentrate fluoride gel

Of the children instructed to brush their teeth once a week with high-concentrate fluoride gel (Elmex gel, 12,500 ppm F^-), 74% did not brush at all with Elmex gel or brushed only once a month; 3% brushed twice a month and only 23% brushed regularly 3–4 times a month with Elmex gel. The use of Elmex gel once a week was not found to be related to the development of new carious lesions ($P = 0.51$).

Multivariate regression analysis (Table 6)

Multivariate analysis revealed that three of the variables independently correlated with the development of new carious lesions (total): brushing regularly twice a day, sweet drinks between meals and number of recall appointments attended.

Similar results were found when analyses included only proximal or only caries requiring crown restoration or extraction as dependent variables.

In the occlusal caries multivariable model, children solely brushing their teeth themselves had an odds ratio of 2.41 (0.94–6.18, $P = 0.067$) to develop occlusal caries compared to children whose parents brushed the child's teeth. No significant differences ($P = 0.99$) were found between children also brushing teeth with parents and only by parents.

DISCUSSION

This historical prospective study affirms the long-term effect of several preventive measures for caries development in a longitudinal 'real life' setting.

Periodic recall appointments

In the present study, it was shown that the number and frequency of periodic recall appointments were negatively correlated with new development of carious lesions. These results are in accordance with Minah et al (2008), who showed that children who attended prevention recall appointments experienced fewer mean carious dental surfaces, and with Wang and Aspelund (2009), who showed that children with a history of broken appointments had higher caries experience. This may relate to several factors: first, early treatment of new carious lesions decreases the levels of *Streptococcus mutans* in the saliva and thereby lowers the risk of healthy teeth to develop new carious lesions. Second, topical application of high-concentrate fluoride gel at the end of each periodic examination/treatment increases the remineralisation of small demineralised lesions and prevents their development by 30% (Petersson et al, 2004; Minah et al, 2008). Moreover, frequent recalls make it possible to seal deep fissures of newly erupting teeth and reseal partially or totally lost sealants, thus decreasing the prevalence of new development of occlusal carious lesions (Jodkowska 2008; Lalloo and Turton 2008; Minah et al, 2008).

Another factor that may contribute to the positive correlation between the numbers of newly developed carious lesions and periodic recalls may be attributed to the fact that at each recall appointment, the compliance with preventive measures and the correct performance of toothbrushing was evaluated and reinforced. The effect of the reinforcement is demonstrated by the finding of the present study that the number and frequency of periodic recalls were also positively correlated with preventive measures performance.

Frequency of toothbrushing

In the present study, a significant negative correlation was found between the frequency of toothbrushing and the number of newly developed carious lesions. In contrast, the frequency of brushing only in the morning was negatively correlated only with teeth needing crowns/extraction. These results emphasise the importance of toothbrushing in the evening and are compatible with the general consensus that toothbrushing in the evening is more important than brushing in the morning.

Levine et al (2007) found a negative correlation between the self-reported frequency of toothbrushing by children of at least once a day and newly developed carious lesions over a 4-year period. Similar results which support the importance of toothbrushing were presented by Chestnutt et al (1998) in Scotland. That study included 2,621 participants and found a negative correlation between caries experience and the frequency of toothbrushing.

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Table 5 Distribution of new carious lesions according to the concentration of fluoride in the toothpaste			
F^- concentration (ppm) in toothpaste	Total caries	Occlusal caries	Smooth-surface caries
>500	20/68 (29.4%)	11/68 (16.2%)	14/68 (20.6%)
500–1100	50/133 (37.6%)	31/133 (23.3%)	32/133 (24.1%)
>1100	86/331 (26.0%)	41/331 (12.4%)	46/331 (13.9%)
P-value	0.05	0.01	0.02

Table 6 Significant variables associated with newly developed carious lesions by multivariate logistic regression analysis				
Variable		OR	95% confidence interval	*P*-value
Age	15 or above	1 (ref.)		
	12–15	0.692	0.294–1.630	0.400
	9–11	1.195	0.551–2.591	0.651
	6–8	1.841	0.823–4.117	0.137
	< 6	0.669	0.239–1.871	0.443
Who brushes child's teeth	Child	1 (ref.)		
	Parent	0.872	0.405–1.877	0.820
	Child and parent	1.099	0.489–2.470	0.428
Water at home	Tap water	1 (ref.)		
	Tap and mineral water	0.437	0.050–3.815	0.454
	Mineral water	1.332	0.842–2.106	0.221
	Filtered by reverse osmosis	2.183	0.359–13.259	0.396
No. of follow-ups*	1	1 (ref.)		
	2–4	0.608	0.358–1.031	0.134
	5–9	0.415		0.065
	10 or above	0.473	0.213–0.807	0.010
F^- concentration in toothpaste	>500	1 (ref.)		
	500–1100	1.195	0.594–2.404	0.617
	>1100	0.781	0.368–1.656	0.519
Sweet drinks between meals*	Yes vs. no	1.98	1.28–3.05	0.002
Toothbrushing frequency*	Twice or more	1 (ref.)		
	Between 1 to 2	1.058	0.431–2.597	.902
	Less than 1/day	1.759	1.121–2.760	0.014

*Statistically significant.

Toothbrushing by the parents or the child

According to the results of the present study, there was a relationship between who brushes the child's teeth and the number of newly developed carious lesions. The highest effectiveness was found when the parent brushed the child's teeth. When the child brushed her/his teeth by her- or himself, the number of newly developed carious lesions increased. The highest number of new occlusal carious lesions was found when brushing was performed alternately by the child and the parents. The reason for these results may be related to the fact that when the child starts to brush her/his teeth

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alone, s/he still lacks the ability to brush effectively; nevertheless, her/his parents assist her/him only occasionally. This may be the reason for the number of the newly developed carious lesions being highest in the transition period. These results are in accordance with Moynihan and Holt (1996), who found that children aged 1.5–4.5 years who brushed their teeth by themselves were at higher risk of developing carious lesions than were children whose parents brushed their teeth.

Eating regular meals

Eating regular meals facilitates the remineralisation of demineralised enamel developed during the meals (Mellberg, 1988). In the present study, eating regular meals was not found to be related to the development of new carious lesions. These results are contrary to those of other studies that found the cariogenicity of food to be related to the duration and frequency of eating meals (Marshall et al, 2003). Nevertheless, these results agree with those of other studies which found that fluoride exposure, oral hygiene habits and genetic factors have a more important role in controlling caries than does the frequency of carbohydrate consumption (Woodward and Walker 1994; Stecksen-Blicks and Holm 1995, Sampaio et al, 2000; Aleksejūniene et al, 2004).

Drinking sugary drinks between meals

In the present study, drinking sugary drinks between meals was positively related to newly developed carious lesions. In hot countries, the frequency of consuming drinks between meals is relatively high, especially among children who spend a significant amount of time outdoors, and therefore it may have a significant impact on caries development. Moreover, since the drinking water in Israel is fluoridated, drinking tap water between meals may decrease the development of new carious lesions and increase the differences between tap- and bottled-water drinkers.

The present results are in accordance with others who found that consuming sugary drinks was positively related to a higher risk for caries development (Ismail et al, 1984; Vnobbergen et al, 2001; Marshall et al, 2007).

Fluoride concentration in toothpaste

In the present study, it was found that fluoride concentration higher than 1100 ppm in toothpaste was related to a lower number of new carious lesions. This was found for all types of carious lesions, both occlusal and smooth-surface. These results agree with those of previous studies (Cahen et al, 1982; Stephen et al, 1988; O'Mullane et al, 1997; Bloch-Zupan, 2001). A review of 70 studies concluded that fluoridated toothpaste decreases the caries development by 24% (Marinho et al, 2003a,b).

One limitation of the present study is the fact that all explanations and examinations were performed by one dentist. This makes the results of the present study difficult to generalise, since compliance might be influenced by the relationship and rapport between the patient and the caregiver. However, this enabled data analysis without the bias of several different examiners.

CONCLUSIONS

Regular toothbrushing twice a day is of great importance for caries prevention. A fluoride concentration of > 1100 ppm in toothpaste should be recommended for children (considering the child's age) in order to maximise the fluoride protective effect. The importance of attending periodic recall appointments in order to maintain long-term oral health should be emphasised.

REFERENCES

1. Aleksejūniene J, Holst D, Balciūniene I. Factors influencing the caries decline in Lithuanian adolescents – trends in the period 1993–2001. Eur J Oral Sci 2004;112:3–7.
2. American Academy of Pediatric Dentistry website, Dental Home Resource Center: http://www.aapd.org/dentalhome/ Accessed April 2010.
3. Ashkenazi M, Cohen R, Levin L. Self-reported compliance with preventive measures among regular attending pediatric patients. J Dent Educ 2007;71:287–295.
4. Bloch-Zupan A. Is the fluoride concentration limit of 1,500 ppm in cosmetics (EU guideline) still up-to-date? Caries Res 2001;35(suppl 1):22–25.
5. Bowen WH, Amsbaugh SM, Monell-Torrens S, Brunelle J. Effects of varying intervals between meals on dental caries in rats. Caries Res 1983;17: 466–471.
6. Cahen PM, Frank RM, Turlot JC, Jung MT. Comparative unsupervised clinical trial on caries inhibition effect of monofluorophosphate and amine fluoride dentifrices after 3 years in Strasbourg, France. Community Dent Oral Epidemiol 1982;10:238–241.

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7. Chestnutt IG, Schäfer F, Jacobson AP, Stephen KW. The influence of toothbrushing frequency and post-brushing rinsing on caries experience in a caries clinical trial. Community Dent Oral Epidemiol 1998;26:406–411.
8. Davies RM, Ellwood RP, Davies GM. The rational use of fluoride toothpaste. Int J Dent Hyg 2003;1:3–8.
9. Deng DM, van Loveren C, ten Cate JM. Caries-preventive agents induce remineralization of dentin in a biofilm model. Caries Res 2005;39: 216–223.
10. Dijkman A, Huizinga E, Ruben J, Arends J. Remineralization of human enamel in situ after 3 months: the effect of not brushing versus the effect of an F dentifrice and an F-free dentifrice. Caries Res 1990;24:263–266.
11. Dong YM, Pearce EI, Yue L, Larsen MJ, Gao XJ, Wang JD: Plaque pH and associated parameters in relation to caries. Caries Res 1999;33: 428–436.
12. Eckersley AJ, Blinkhorn FA. Dental attendance and dental health behaviour in children from deprived and non-deprived areas of Salford, north-west England. Int J Paediatr Dent 2001;11:103–109.
13. Ismail AI, Burt BA, Eklund SA. The cariogenicity of soft drinks in the United States. J Am Dent Assoc 1984;109: 241–245.
14. Jodkowska E. Efficacy of pit and fissure sealing: long-term clinical observations. Quintessence Int 2008;39:593–602.
15. Jones S, Hussey R, Lennon MA. Dental health related behaviours in toddlers in low and high caries areas in St Helens, north west England. Br Dent J 1996;181:13–17.
16. Lalloo R, Turton MS. Fissure sealants on permanent first molars-consequences of a one-year delay. Community Dent Health 2008;25:191–192.
17. Lee CM, Blain SM, Duperon DF. Parents' self-reported compliance with preventive practices after witnessing their child undergo intravenous sedation for dental treatment. ASDC J Dent Child 2002;69: 77–80.
18. Levin L, Shenkman A. The relationship between dental caries status and oral health attitudes and behavior in young Israeli adults. J Dent Educ 2004;68: 1185–1191.
19. Levine RS, Nugent ZJ, Rudolf MC, Sahota P. Dietary patterns, toothbrushing habits and caries experience of schoolchildren in West Yorkshire, England. Community Dent Health 2007;24:82–87.
20. Marinho VC, Higgins JP, Logan S, Sheiham A. Topical fluoride (toothpastes, mouthrinses, gels or varnishes) for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2003a;4:CD002782.
21. Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2003b;1: CD002278.
22. Marshall TA, Eichenberger-Gilmore JM, Larson MA, Warren JJ, Levy SM. Comparison of the intakes of sugars by young children with and without dental caries experience. J Am Dent Assoc 2007;138:39–46.
23. Marshall TA, Levy SM, Broffitt B, Warren JJ, Eichenberger-Gilmore JM, Burns TL, Stumbo PJ. Dental caries and beverage consumption in young children. Pediatrics 2003;112: e184–e191.
24. Mellberg JR. Remineralization. A status report for the American Journal of Dentistry. Part I. Am J Dent 1988;1:39–43.
25. Minah G, Lin C, Coors S, Rambob I, Tinanoff N, Grossman LK. Evaluation of an early childhood caries prevention program at an urban pediatric clinic. Pediatr Dent 2008;30: 499–504.
26. Moynihan PJ, Holt RD. The national diet and nutrition survey of 1.5 to 4.5 year old children: summary of the findings of the dental survey. Br Dent J 1996;181:328–332.
27. O'Mullane DM, Kavanagh D, Ellwood RP, Chesters RK, Schafer F, Huntington E, Jones PR. Three-year clinical trial of a combination of trimetaphosphate and sodium fluoride in silica toothpastes. J Dent Res 1997;76:1776–1781.
28. Petersson LG, Twetman S, Dahlgren H, Norlund A, Holm AK, Nordenram G, Lagerlöf F, Söder B, Källestål C, Mejàre I, Axelsson S, Lingström P. Professional fluoride varnish treatment for caries control: a systematic review of clinical trials. Acta Odontol Scand 2004;62:170–176.
29. Sambunjak D, Nickerson JW, Poklepovic T, Johnson TM, Imai P, Tugwell P, Worthington HV. Flossing for the management of periodontal diseases and dental caries in adults. Cochrane Database Syst Rev 2011;7(12):CD008829.
30. Sampaio FC, Hossain AN, von der Fehr FR, Arneberg P. Dental caries and sugar intake of children from rural areas with different water fluoride levels in Paraíba, Brazil. Community Dent Oral Epidemiol 2000;28:307–313.
31. Stecksen-Blicks C, Holm AK. Between-meal eating, toothbrushing frequency and dental caries in 4-year-old children in the north of Sweden. Int J Paediatr Dent 1995;5:67–72.
32. Stephen KW, Creanor SL, Russell JI, Burchell CK, Huntington E, Downie CF. A 3-year oral health dose-response study of sodium monofluorophosphate dentifrices with and without zinc citrate: anti-caries results. Community Dent Oral Epidemiol 1988;16:321–325.
33. Vnobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. Assessing risk indicators for dental caries in the primary dentition. Community Dent Oral Epidemiol 2001;29:424–434.
34. Wang NJ, Aspelund GO. Children who break dental appointments. Eur Arch Paediatr Dent 2009;10:11–14.
35. Woodward M, Walker AR. Sugar consumption and dental caries: evidence from 90 countries. Br Dent J 1994;176: 297–302.
36. Zaura E, ten Cate JM. Dental plaque as a biofilm: a pilot study of the effects of nutrients on plaque pH and dentin demineralization. Caries Res 2004;38(suppl 1): 9–15.