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Effects of fluoride tablets on caries and fluorosis occurrence among 6- to 9-year olds using fluoridated salt

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Abstract – *Objective:* The aim of this retrospective cohort study was to investigate the association between the use of fluoride tablets among users of fluoridated salt and the occurrence of caries and fluorosis. *Materials and methods:* We examined 583 school children aged 6–9 years in Berlin, Germany for caries-status (modified defs ≥ 1; d_3-level) and fluorosis occurrence on central incisors (TSIF ≥ 1). Parents completed questionnaires about several sociodemographic and oral health related factors of the previous years. To adjust for confounding, we used log-risk regression and estimated relative risks (RR) and 95% confidence intervals. *Results:* The mean modified defs was 3.2 (SD = 5.9) and 58% children were caries-free. Twenty-two per cent of the children revealed mild fluorosis (TSIF 1 and 2). Length of fluoride tablet use was inversely associated (adjusted for age and SES) with caries-status: 2–4 years: RR = 0.8, 95%CI: 0.7–1.0, ≥5 years: RR = 0.5, 95%CI 0.3–0.7 (reference: 0–1 year use). This inverse association could mainly be observed in children who consumed fluoridated salt as well. Relative risks for mild fluorosis were 1.8 (95%CI: 1.1–2.9) and 2.7 (95%CI: 1.6–4.5) for fluoride tablet use of 2–4 years and ≥5 years, respectively compared with 0–1 year use. *Conclusions:* Fluoride tablets seem to be effective in reducing the occurrence of caries in children with low caries levels in particular among those using fluoridated salt as well. However, fluoride tablets increase the occurrence of mild fluorosis in permanent incisors.

Key words: caries prevention; defs; epidemiology; fluoride tablets; salt fluoridation; TSIF

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Fluoride is delivered through various self- and professionally applied means including toothpastes, gels, rinses, and varnishes. Moreover, as a community based intervention fluoride has been adjusted upward to water or salt. In some countries, foremost with no water fluoridation, fluoride supplements as drops, lozenges, and tablets (in combination with vitamin D) are recommended for caries prevention to mimic the 'systemic' fluoride delivery (1).

The relative effects of pre- and posteruption exposure of fluoride on caries experience of first permanent molars of 6- to 15-year-old Australian children showed an important pre-eruptive role of fluoride for overall DMFS of first molars (2) and for pit and fissure surfaces (3) corroborating earlier studies (4). However, impact of pre-eruptive caries preventive effects of fluorides is still a matter of debate. In particular, the risk of aesthetically relevant dental fluorosis may be increased among children aged 5–8 years as a result of multiple fluoride exposure (i.e. fluoride tablets, toothpaste and salt). Concerns about the appropriateness of fluoride supplements as a caries preventive agent

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(4–6) resulted in a reduction of recommended fluoride supplement dosage schedules in many countries in the beginning of the 1990s (7, 8). Nevertheless, fluoride supplementation starting with birth is still recommended in many countries, obviously because of professional reluctance (7) and/or difficulties of various professional societies to agree on recommendations as it has been observed in Germany (9, 10).

For fluoride supplements, several prospective randomized studies mainly conducted in the 1980s are available focusing on their effects on caries incidence in young children (11–13), schoolchildren (14, 15) or the elderly (16). However, for the studies in children several limitations including a rather high drop-out rate (11, 14) and a low caries-incidence (12) have to be considered. In these six studies mainly beneficial effects from the intake of fluoride supplements on caries incidence were reported. Data from retrospective (17) and cross-sectional studies (18) corroborated these results. Only four of these studies studied fluorosis prevalence or incidence (12, 14, 17, 18) simultaneously. Few studies (12, 17) on the risks (fluorosis) and benefits (lower caries occurrence) of fluoride supplementation in young children were conducted during the last two decades when a lower caries prevalence has been reported throughout Europe (19) as it was observed in the earlier studies.

Besides fluoride supplements and toothpaste, fluoridated salt has been introduced in several countries in the 1990s (20). In Germany, fluoridated salt (250 ppm) was introduced in 1991; meanwhile it has reached a market share of 63% (21). Salt fluoridation has been shown to be effective in prospective study designs in populations with higher caries prevalence as the present (22). Cross-sectional studies corroborated these results in more recent years (23–26).

Children born in the second half of the 1990s in Germany might have been exposed to fluorides from various sources including fluoride tablets containing 0.25 mg F (or even 0.5 mg), fluoridated salt (250 ppm), and toothpaste with reduced fluoride concentrations (250–500 ppm). Thus, the aim of the present retrospective cohort study was to assess risks and benefits of the use of fluoride tablets among children consuming fluoridated salt in a population (no water fluoridation) with a relatively high socioeconomic status (27) taking into account several potential confounders and potential effect modifiers.

Materials and methods

Study area and population

This retrospective cohort study was carried out in four basic schools in the district Steglitz-Zehlendorf in Berlin, Germany in cooperation with the Public Dental Services (PDS). Approval of the study was given by the Senate Office for Education, Youth and Sports as well as by the principals of the selected schools. Ethical approval was obtained from the University's Ethical Committee (EA4/017/2004) prior to the start of the study.

In Germany, schools are visited by the PDS on a regularly basis. Those schools that were consecutively visited by the PDS of Steglitz-Zehlendorf from December 2004 to May 2005 (four of 35 basic schools in the district) were included. Of a total of 1004 enrolled children in the 1st–3rd grade of these schools, 969 were asked to participate about 2–4 days prior to examination. Participating parents gave written informed consent.

Questionnaire

Sociodemographic characteristics including gender and age as well as level of mother's and father's education [dichotomized as basic (up to 9 years of school)/and high (10 or more years)], residency since birth (Berlin/other), and mother's nationality (dichotomized as German/other) were recorded. Oral health questions dealt with fluoride delivery up to the age when intake of fluoride tablets was stopped (no use/1 year/2–4 years/≥5 years), the duration of use of fluoridated salt (no use/<5 years/≥5 years), use of fluoridated gel (no and irregular/once a week), the application of fluoride varnish (never/ever), use of children's toothpaste (fluoridated/nonfluoridated), amount of children's toothpaste used (≤pea size/>pea size), age when brushing help was stopped (≤4 years/>4 years), daily brushing frequency (≤1 daily/≥2 daily), age of first dental visit (with tooth eruption/3–5 years/≥6 + never), frequency of annual dental visits (1–2/≥3), and sweets consumption (seldom/≥daily).

Clinical examination

A single examiner (EG), a dentist, was trained by an experienced dentist (HML) prior to the study. Children (n = 583) were surveyed by the examiner, who was blinded to the questionnaire information. Examinations were performed under artificial light in school rooms with a dental mirror and a wooden spatula to hold off lips and tongue. Lesions at the dentinal level (d_3) either with or without visual or tactile cavitations were judged as decayed. Sealants were not observed in primary teeth. For all ages we accounted incisors not being present in the oral cavity as exfoliated, but not as 'missing' in the modified def index. For 6-/7-year olds, teeth 3, 4, and 5 were always counted as 'missing'. If 8- and 9-year olds had missing teeth, they were either asked whether the tooth had been extracted because of pain or destruction or the contralateral tooth was judged with respect to mobility. If increased tooth mobility was not observed, the missing contralateral tooth accounted as 'missing', otherwise as exfoliated. This way, of all teeth 3, 4, and 5 in 6- to 9-year olds, 96 accounted as 'missing' and 370 as 'exfoliated'.

Mottling as a result of fluorosis on the labial surfaces of the permanent upper central incisors was assessed using the Tooth Surface Index of Dental Fluorosis (TSIF). The higher of two scores was taken as the common score for a pair of homologous teeth being erupted at least 75%. In absence of a homologous pair of central incisors, the score of the single present incisor was considered for TSIF (n = 487).

Statistical analyses

To study the reliability of the caries assessment, we did not do a test–retest assessment of the children. Instead, we measured intra-examiner consistency by comparing the caries scores (modified defs) of primary teeth of one side with that of the other side. Pearson's correlation coefficients of modified defs between both sides were calculated and corrected (arbitrary genuine variance because of variations of dmfs between both sides was subtracted from total error variance) to determine the reliability coefficient (28); this method has been discussed in a previous paper (29). The reliability estimate of modified defs was 0.89.

For descriptive analyses, the TSIF index was dichotomized: no fluorosis (TSIF = 0) and mild fluorosis (TSIF = 1 + 2). Number of children with 'caries-free' primary teeth (modified defs < 1) was calculated. Mean [SD (standard deviation)] as well as median [Q1 (25th percentile), Q3 (75th percentile)] modified defs, ds, ms, and fs values (30) stratified by age when fluoride tablets intake was stopped were analysed. Furthermore, these values were stratified according to use of fluoridated salt (never/ever). The ratio of decayed surfaces (ds) over decayed plus filled (fs) surfaces was calculated. Baseline characteristics as well as percentage frequency distributions of the interview data of both areas were depicted (SPSS 11.5; SPSS, Munich, Germany).

To estimate adjusted relative risks (RR) and corresponding 95% confidence intervals, we set up log-risk regression models by use of PROC GENMOD (SAS 9.1; SAS Institute, Cary, NC, USA). Outcomes were dichotomized as follows: caries (modified defs = 0/modified defs ≥1) and fluorosis score on upper central incisors (TSIF = 0/TF ≥ 1). Years of intake of fluoride tablets was categorized as: 0–1 year (reference group), 2–4 years, and 5 or more years. To identify the minimal sufficient set of adjustment variables, we used a directed acyclic graph (DAG) (31) to specify our assumed causal structures. According to our DAG, age and SES as measured by mother's education attainment (basic /high) belonged to the minimal sufficient adjustment set. Regression model no. 1 presents the unadjusted model that provides the crude effect estimates. Model no. 2 adjusts for the identified minimal sufficient adjustment set of confounders.

We studied the sensitivity of our results by several analyses: we considered the 43 children with missing information on fluoride tablet use as unexposed. In another analysis, we considered these children as fluoride tablet users until an age of 2–4 years. Furthermore, we studied the sensitivity of our results because of caries misclassification by changing the threshold of caries classification from score 1 to score 2.

We used disjoint indicator variables to categorize the years of fluoride tablet intake (reference: 0–1 year, 2–3 years and ≥4 years). To study the modifying effect of intake of fluoridated salt (ever/never) on the association between fluoride tablet intake and the risk of caries, we stratified our analyses by use of fluoridated salt.

Results

Descriptive analyses

Informed consent was obtained from the parents of 583 children of 969 children (response: 60%). Thus, we studied a 8% sample of all school children in the district of Steglitz-Zehlendorf in the school year 2005/2006 (about 7000 children). Almost every child included was born in Germany (99%) and mainly in Berlin (91%), but only 80% had mothers of German nationality. Participating children were on average 7.7 (SD: 1.0) years old.

The modified defs and ds scores showed a skewed distribution to the right with 58% of children being 'caries-free' (Fig. 1). Mean (SD) modified defs was 3.2 (5.9) [median (Q1;Q3): 0 (0;4)]. Mean (SD) ds, ms, and fs were 1.2 (3.3) [median (Q1;Q3): 0 (0;0)], 0.7 (3.3) [median (Q1;Q3): 0 (0;0)], and 1.3 (2.5) [median (Q1;Q3): 0 (0;2)], respectively. Fifty-four per cent of the cavities in primary teeth in need of a restoration were actually filled. Mild fluorosis (TSIF 1 and 2) could be found in 22% of 487 children having at least one upper permanent central incisor erupted.

Duration of fluoride tablet intake was negatively associated with modified defs: the longer the duration of intake, the lower the modified defs (n = 528) even after exclusion of high caries-risk children (non-German, basic mother's educational attainment) (n = 386). Percentages of mild fluorosis on upper central incisors were highest for long-time users of fluoride tablets. Stratification of relative risk estimates for fluoride tablets by the use of fluoridated salt (never/ever) revealed a stronger preventive effect for ever salt users compared with never salt users. However, the risk of fluorosis due to fluoride tablets was only slightly modified by fluoridated salt intake (Table 1). We observed a similar gradient of modified defs index. Non- and short-users of fluoride tablets had relatively more missing teeth than longer users.

Several factors were associated with the caries-status (modified defs ≥ 1) as it can be depicted from the descriptive data in Table 2 (shown by cumulative risks). Nonetheless, the vast majority of these factors does not qualify as confounding factors according to our DAG. Younger age group, German nationality, longer use of fluoride tablets, and fluoridated salt, smaller amounts of toothpaste, longer periods of brushing help, higher daily brushing frequency, lower number of annual dental visits, and higher level of school attainment of parents were all negatively associated with caries. Longer duration of fluoride tablet intake, fluoridated salt use as well as higher level of mother's school attainment were associated with higher risks of mild fluorosis (Table 2).

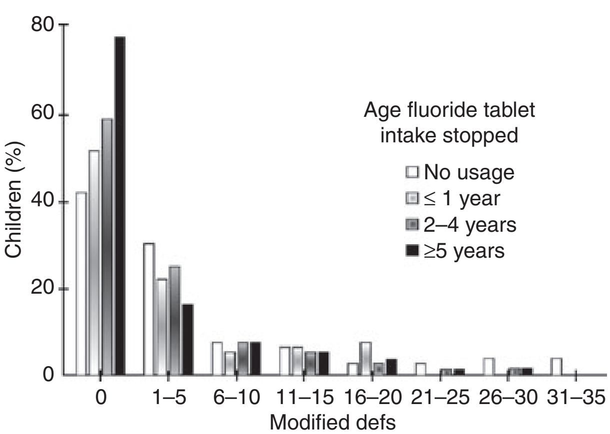

Fig. 1. Distribution of modified defs scores according to age when intake of fluoride tablets ceased.

Regression analysis of caries-status and mild fluorosis

Duration of fluoride tablet intake was associated with a decreased risk of caries experience (see model nos 1 and 2). The estimated relative risks for fluoride tablet intake over a period of 2–4 and ≥5 years were 0.8 (95%CI: 0.7–1.0) and 0.5 (95%CI: 0.3–0.7), respectively. Our sensitivity analyses did not markedly change our results related to the effect of fluoride tablet intake on risk of caries experience. Stratified analyses with respect to salt fluoridation showed that an effect of fluoride tablet use on caries experience could mainly be observed in children who consumed fluoridated salt as well (Table 3).

Relative risk estimates of occurrence of mild fluorosis were 1.8 (95%CI: 1.1–2.9) and 2.7 (95%CI: 1.6–4.5) for fluoride tablet use of 2–4 years and ≥5 years, respectively. Sensitivity analyses for missing data on fluoride tablet intake revealed slightly weaker relative risk estimates when subjects with missing data were accounted as nonexposed. Stratified analyses with respect to 'salt' showed similar risk estimates for never and ever users with respect to the association of fluoride tablet use and mild fluorosis (Table 4).

Discussion

In this study, we provide evidence that intake of fluoride tablets among young children decreases the risk of caries at early school age. We found a dose-response like pattern with lower relative risk of caries the longer the use of fluoride tablets. The preventive effect of fluoride tablets was mainly restricted to children, who additionally consumed fluoridated salt. However, the risk of fluorosis was not higher among children with both exposures, i.e. fluoride tablets and fluoridated salt, as compared with children with use of fluoride tablets only.

Few well-conducted randomized clinical trials concerning the effects of fluoride supplements in schoolchildren are available (7, 11–15). The effects of fluoride tablets in combination with other means

Table 1. Mean and median modified defs values as well as percentages of mild fluorosis (TSIF 1 and 2) according to age when intake of fluoride tablets was stopped

	Age fluoride tablet intake stopped			
Group	Not used	1 year	2–4 years	≥5 years
All				
Modified defs (n = 528)				
Mean (SD)	4.5 (7.5)	3.8 (6.2)	2.9 (5.5)	1.3 (3.9)
Median (Q1;Q3)	2 (0; 5)	0 (0; 5)	0 (0; 6)	0 (0; 0)
n	118	60	260	90
Mild fluorosis (n = 437)				
%	12	13	23	35
n	100	45	213	79
Low-risk children				
Modified defs (n = 386)				
Mean (SD)	2.9 (4.9)	2.8 (5.1)	1.8 (3.7)	0.7 (2.1)
Median (Q1;Q3)	0 (0; 4)	0 (0; 4)	0 (0; 2)	0 (0; 0)
n	77	47	191	71
Mild fluorosis (n = 317)				
%	9	16	25	32
n	66	32	155	64
All; Salt = never				
Modified defs (n = 151)				
Mean (SD)	4.1 (7.3)	4.2 (7.1)	3.7 (6.6)	2.1 (4.5)
Median (Q1;Q3)	0.5 (0; 4)	0 (0; 6)	0 (0; 4)	0 (0; 2)
n	40	25	68	18
Mild fluorosis (n = 128)				
%	12	11	16	41
n	34	18	57	17
All; Salt = ever				
Modified defs (n = 357)				
Mean (SD)	4.6 (7.3)	3.6 (7.5)	2.7 (5.1)	1.1 (3.7)
Median (Q1;Q3)	2 (0; 5)	0 (0; 5)	0 (0; 4)	0 (0; 0)
n	74	34	179	71
Mild fluorosis (n = 293)				
%	11	15	25	33
n	62	26	144	61

Subset for low caries-risk children (German nationality, higher mother's education) as well as stratified analyses with respect to use of fluoridated salt (never/ever) for all children were performed.

of fluoridation (i.e. salt fluoridation) have not been studied in detail before. As it is considered to be ethically unacceptable to randomize fluoridation, observational studies on the effectiveness of fluoridation are an important means to study this association. However, confounding may complicate the results of observational studies. Therefore, we applied adequate methodology (directed acyclic graphs) to identify the minimal sufficient set of adjustment variables and consequently adjusted for these variables. This methodology allowed us to address confounding and to obtain risk estimates with rather narrow confidence intervals with a number of approximately 500 children being examined. Adjusted relative risks were weaker than the crude relative risks, but still a clear association could be revealed.

Our data confirm previous findings in a population with even lower caries levels at a similar fluorosis prevalence in Norway, where mostly lozenges were recommended (17, 32). Moreover, in Norwegian children lower caries experience has been attributed to increased sales of fluoride supplements (33). Although lozenges being chewed or sucked are supposed to be more beneficial because of an increased topical effect (7, 34), data of the present study suggest that fluoride tablets, if recommended to be sucked, seem to have a caries-preventive effect as well. A rather high proportion of 78% reported use of fluoride tablets at least for the first year of life. It might be speculated that the combination with vitamin D (as in Germany) might support parents' compliance, because hitherto two health problems are intended to be prevented with one drug schedule.

However, benefits from fluoride supplements have been claimed to be available through fluoride toothpaste with fairly minor lifestyle changes as

Table 2. Frequency distributions of the socioeconomic and oral health related characteristics of the 6- to 9-year olds from the interviews of the parents as well as cumulative risk estimates of both outcomes caries and fluorosis

Variable	Group size (*n*)	%[a]	Caries, *n* (CR)	Group size (*n*)	%[a]	Fluorosis, *n* (CR)
Age						
6 + 7 years	255	44	87 (34)	169	35	41 (24)
8 + 9 years	328	56	161 (49)	318	65	68 (21)
Residency since birth						
Berlin	532	91	226 (42)	450	92	102 (23)
Other	50	9	22 (44)	37	8	7 (19)
Nationality						
German	465	80	172 (34)	388	80	90 (23)
Other	116	20	75 (65)	99	20	19 (19)
Sex						
Male	266	46	116 (44)	221	45	48 (22)
Female	317	54	132 (42)	266	55	61 (23)
Age fluoride tablet intake stopped						
Not used	118	22	68 (58)	100	23	12 (12)
1 year	60	11	28 (47)	45	11	6 (13)
2–4 years	262	50	107 (41)	215	49	50 (23)
≥5 years	90	17	21 (23)	79	17	28 (35)
Duration of use of fluoridated salt						
No salt	165	30	75 (46)	138	30	24 (17)
<5 years	181	32	78 (43)	149	32	37 (25)
≥5 years	213	38	85 (40)	177	38	40 (23)
Fluoride varnish						
Never	259	46	113 (44)	209	45	45 (22)
Ever	303	54	128 (42)	259	55	59 (23)
Fluoridated gel						
No/irregular	452	81	191 (42)	376	81	81 (22)
Once a week	105	19	48 (46)	90	19	23 (26)
Children's toothpaste						
No fluoride	35	7	17 (49)	31	7	6 (19)
Fluoride	499	93	205 (41)	412	93	95 (23)
Amount children's toothpaste						
≤Pea size	271	55	90 (33)	219	54	44 (20)
>Pea size	224	45	113 (50)	190	46	48 (25)
Brushing help stopped at age						
≤4 years	293	52	142 (49)	239	50	53 (22)
≥5 years	272	48	104 (38)	237	50	55 (22)
Daily brushing frequency						
≤1 daily	91	16	52 (57)	75	16	21 (28)
≥2 daily	489	84	195 (40)	410	84	88 (22)
Age of first dental visit						
Eruption	94	16	37 (39)	74	15	21 (28)
3–5	438	76	194 (44)	372	77	79 (21)
≥6 + never	46	8	14 (30)	37	7	8 (22)
Annual frequency dental visits						
1–2	399	74	150 (38)	334	73	82 (25)
≥3	142	26	79 (56)	123	27	20 (16)
Sweets consumption						
Seldom	233	40	98 (42)	193	40	45 (23)
≥Daily	350	60	150 (43)	294	60	64 (22)
Mother's education						
Basic	75	13	50 (67)	67	14	11 (16)
≥High school.	494	87	192 (39)	409	86	96 (24)
Father's education						
Basic	89	16	50 (56)	74	16	14 (19)
≥High school	465	84	183 (39)	390	84	91 (23)

n, number of children, CR, cumulative risk.
[a]Column percentage within each independent variable.

Table 3. Estimated relative risks and 95% confidence intervals for the association between years of fluoride tablet intake and risk of caries among children in Berlin

	Crude relative risk estimates (n = 528)	Adjusted model[a] (n = 516)	Model[a] for never users of fluoridated salt	Model[a] for ever users of fluoridated salt
Years of fluoride tablet intake				
Not used + 1 year	Reference	Reference	Reference	Reference
2–4 years	0.8 (0.6–0.9)	**0.8 (0.7–1.0)**	1.0 (0.7–1.3)	0.7 (0.6–0.9)
≥5 years	0.4 (0.3–0.6)	**0.5 (0.3–0.7)**	0.8 (0.4–1.7)	0.4 (0.2–0.6)

[a]Adjusted for age and SES. Risk estimates of the main model are highlighted with bold numbers.

Table 4. Estimated relative risks and 95% confidence intervals for the association between years of fluoride tablet intake and risk of fluorosis among children in Berlin

	Crude relative risk estimates (n = 528)	Adjusted model[a] (n = 516)	Model[a] for never users of fluoridated salt	Model[a] for ever users of fluoridated salt
Years of fluoride tablet intake				
Not used + 1 year	Reference	Reference	Reference	Reference
2–4 years	1.9 (1.1–3.0)	**1.8 (1.1–2.9)**	1.4 (0.5–3.6)	1.9 (1.0–3.4)
≥5 years	2.9 (1.7–4.8)	**2.7 (1.6–4.5)**	3.6 (1.4–9.3)	2.5 (1.3–4.8)

[a]Adjusted for age and SES. Risk estimates of the main model are highlighted with bold numbers.

well. This study did not aim to compare the effects of use of either fluoride toothpaste or tablets. In general, children with high caries risk would benefit the most from regular use of fluorides from either source. These children most possibly belong to families with lower socioeconomic status (SES) that are more likely to be noncompliant (35). Thus, a community-based means of fluoridation (i.e. fluoridated drinking water or salt) might be more adequate to deal with oral health problems as a result of social inequalities (1).

The association between fluoride tablet intake and caries risk was stronger in the group of children that also used fluoridated salt at home. This observation might either be ‘true’ or an artefact because of residual confounding and/or information bias. It might be speculated that those families using fluoridated salt are also more compliant with other preventive regimes. Thus, these individuals might have used fluoride tablets more frequently (frequency was not assessed) than never users of salt. Nonetheless, frequent local fluoride application as provided by daily use of fluoridated salt should favour remineralization of enamel (36) probably resulting in lower caries occurrence.

For children using fluoride tablets for more than 5 years, higher fluorosis risk of upper central incisors compared with those using tablets for 2–4 years could be observed. This is partially biologically implausible, since risk of developing fluorosis of these teeth is diminished approximately at an age of 2–4 years (37). This observation corroborates the assumption that children of both categories did not only differ with respect to the length, but also the frequency of fluoride tablet intake during maturation of aesthetically relevant teeth. With similar (low) frequency, risk estimates for users of ≥5 years for caries-status might have been closer towards the null (RR = 1).

There are several factors that limit our results. First, estimates of fluoride tablet intake (years, type of supplementation, etc.) during the previous years were based on self-reports of the parents that may contain errors that can potentially bias our study results. One might assume that low educational attainment results in less reliable reports of length of fluoride intake. As we adjusted for mother’s educational attainment, we dealt with this bias in the regression model. According to our DAG, all other potential confounders (except for age) could be omitted in the model. Second, the response proportion was 60%. If response was associated with both the fluoride supplementation and the caries risk, nonresponse bias would occur. In addition, if nonresponders had higher caries levels as has been shown in previous studies (38, 39), data might not be representative for the studied district. However, the modified defs distribution of this study was quite comparable with that of the PDS from 2002 (G. Baller, personal communication). Third, we included children who used fluoride tablets up to 1 year of age in the group of 'unexposed' to avoid lack of convergence of the log risk regression models. One might argue that the choice of nonusers alone would have been more appropriate. However, no differences in caries-status could be found between children starting use of fluoride supplements from birth and those starting with 7 months of age (13). Moreover, as fluoride is supposed to exert mainly topical effects (1), one might argue that fluoridation should be implemented after eruption of teeth. Those teeth being mostly affected by caries in young children are the primary molars that will generally not erupt before 12 months of age. Therefore, the chosen comparison group seems to be adequately chosen for the outcome caries. Nonetheless, implementation of fluoridation before eruption and its continued use might bear advantages, if a pre-eruptive effect is assumed as well, but also to achieve better compliance during childhood. With respect to the outcome fluorosis nonusers and first year users of fluoride tablets showed quite similar fluorosis occurrence. Thus, merging these two groups of children for the regression analyses seemed to be adequate. Fourth, for hygienic reasons (no adequate sterilization) no dental probe was used, which does not meet the requirements of the WHO for epidemiological studies (30). However, it is widely accepted that the use of an explorer does not improve the diagnosis of pit and fissure caries (40). Moreover, no dental chairs and professional light sources were available. Notwithstanding, the use of artificial light sources allowed discerning frank caries at the dentinal level (d_3 level – with and without cavitated surfaces) appropriately. Generally, it has to be considered that caries detection at the dentinal level shows variation among various examiners despite of calibration that complicates comparison between various studies (41). Fifth, instead of dmfs or defs indices a modified defs index was used, accounting for some teeth not being present in the oral cavity as 'missing' (21%) as a result of caries and others as 'exfoliated'. Stratified descriptive analysis with respect to use of fluoride tablets and salt fluoridation was similar using either ds or modified defs. For the regression model, definition of 'missing' did not affect risk estimates, because only six of 248 individuals, who were registered as dmft >0 had a dft = 0 and mt > 0.

In conclusion, we provide evidence that use of fluoride tablets in young children decreases the risk of caries at school age in particular when fluoridated salt is used as well. However, ingestion of fluoride tablets increases the risk of mild fluorosis in permanent incisors. The observed combined effect of fluoridated salt and fluoride tablets should be considered further in a prospective cohort study.

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