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ORIGINAL ARTICLE

Are pit and fissure sealants needed in children with a higher caries risk?

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Abstract The aim of this cross-sectional study was to analyse the preventive need of pit and fissure sealants (PFS) in a German population with a relatively high caries risk. The study involved 311 8- to 12-year-old children from the Ennepe–Ruhr District in North Rhine-Westphalia, Germany. Caries experience was scored according to WHO (1997) and ICDAS II criteria. PFS were assessed as intact or partially lost. The mean DFS values amounted to 0.5 for occlusal fissures, 0.2 for palatal/buccal pits and 0.3 for the remaining teeth. Non-cavitated caries lesions were recorded in average on 1.8 occlusal fissures and 1.5 palatal/buccal pits. Sealants were registered on 1.4 occlusal fissures and 0.4 palatal/buccal pits. The descriptive data and the adjusted Poisson regression models revealed that children with at least one fissure sealant are less likely to have decayed fissures or fissures with non-cavitated lesions on their permanent molars. Therefore, PFS are needed and indicated in caries-risk children.

Keywords Dental caries · Epidemiology · Prevention · Pit and fissure sealants · Caries risk

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Introduction

Sealant materials are most commonly placed on caries susceptible sites of palatal/buccal pits and occlusal fissures of permanent molars in order to prevent the development of a caries process and/or to stop the progression of an existing non-cavitated caries lesion until they are completely retained [1]. While the clinical indication for preventive pit and fissure sealants (PFS) could include the sealing of primary molars, premolars as well as the foramina caeca in anterior teeth, recently published systematic reviews and guidelines [1–8] recommend their application explicitly in high-caries-risk children. Contrary to this, Heyduck [9] and Heyduck et al. [10] reported that German adolescents with a high baseline decayed/missing/filled surface (DMFS) and a large number of sealants have a higher relative risk of an overall caries increment compared to those with a high baseline DMFS but no or few sealants. Based on these findings, the authors concluded that there is only a limited preventive effect of sealants in 12- to 15-year-old children and recommended their use only in low-caries-risk patients. The consideration of their study methodology, however,

reveals several issues: (1) major point of criticism is the abandonment of surface-related analyses that take into account the clinical appearance of occlusal fissures and palatal/buccal pits. (2) Non-cavitated caries lesions were not recorded—despite their high prevalence in children and adolescents [11, 12]. (3) The authors only scored sealants that were at least 50% retained. These circumstances make it difficult to compare the results and conclusions with other studies. Therefore, our study focused special emphasis on those three aspects in another German population. It primarily aimed to register in detail the clinical appearance of occlusal fissures and palatal/buccal pits in a population of higher caries risk. The null hypothesis is that dental health is similar in children with and without PFS. Secondly, the preventive need of PFS should be assessed. This aim is in line with the need of further information about the question whether PFS are indicated in patients with a higher caries risk or not [3].

Materials and methods

Study population

This analytical cross-sectional epidemiological study involved 311 children aged 8, 10 and 12 years with a relatively high caries risk from the Ennepe–Ruhr District (EN) in North Rhine-Westphalia, Germany. One hundred forty-two 8-year-old children (78 male/64 female), 54 10-year-old children (26/28) and 115 12-year-old children (61/54) were examined. The selection of schools and children was based on the following criteria:

1. Epidemiological data obtained from the annual dental screenings across the EN district indicated a significantly higher caries experience in children who went to one of the included schools. The previously recorded decayed/missing/filled teeth (DMFT) values for the included primary schools and secondary general schools (Hauptschulen) showed the highest values in the EN district.
2. School selection was further based on the catchment area, which showed that the included schools are located in socially deprived areas.
3. The social data revealed that nearly half of the children come from families with an immigration background and/or low socio-economic status.
4. According to the available financial and personnel resources of the public dental health department a maximum of 15 schools could be included in an intensified preventive programme.

Thus, the selected four primary schools as well as the 11 secondary general schools represent children with the highest caries experience and the highest caries risk in the EN district according to the available population-based data. For these children, a school-based caries preventive programme was implemented by the local public dental health office. The programme included regular dental check-ups at the schools and lessons in dietary advices to promote a healthy and tooth-friendly diet, a tooth-brushing programme with fluoridated toothpaste (1,400 ppm) as well as fluoride varnish application twice a year (Duraphat®, 22,600 ppm NaF, Colgate-Palmolive, Hamburg). To comply with the legal requirements in Germany no PFS were applied by the dentists of the dental public health department. All recorded PFS were placed by local private dental practitioners. Therefore, information about timing, diagnosis, indication, clinical procedure and materials were not available. With the consent of the parents, 87% of all children of the selected schools participated in the school-based preventive programme in the school year of 2004/2005. Dental health records were available from nearly 70% of all 8- to 12-year-old children (N=311). The most common reasons for no participation on the meticulous dental examination were the absence of a child at the day of the investigation or the rejection of the oral examination by the child.

Clinical examination

The caries status according to the WHO standard was determined as DMFS index [13] for each tooth surface by a calibrated examiner (H.S.) using a dental mirror, a CPI probe (CP-11.5B6, Hu-Friedy, Chicago, IL, USA) and a halogen lamp (Mach Miniflex, Dr. Mach, Ebersberg, Germany). In the second part of the clinical examination, another calibrated examiner (S.B.) recorded non-cavitated caries lesions and PFS following to a professional cleaning in a dental mobile (Mercedes-Benz Sprinter, Daimler Chrysler AG, Stuttgart, Germany) equipped with a dental unit (1300HK, Ultradent, Munich, Germany). The occlusal fissure pattern as well as the upper palatal and the lower buccal pits of the first permanent molars were examined. For detection of non-cavitated caries lesions according to ICDAS II criteria [14, 15], each molar was isolated with cotton rolls and force-air-dried for 5 s. A head loupe (fourfold magnification, Lactona, American Opticals, USA) was used. First and distinct visual enamel changes as well as localised enamel breakdowns were summarised in one score as they indicated non-cavitated caries lesions. Bitewing radiographs were not applicable to detect clinical not detectable enamel and dentine caries lesions.

Both intact and partially retained PFS were registered. If a filling did not cover the whole fissure pattern, as well as in cases of partially sealed fissures and pits, the uncovered fissure system was also assessed according to the ICDAS criteria, thus sometimes leading to multiple findings for the same tooth surface.

Prior to the field study, the investigator (S.B.) took part on a calibration training with a separate sample including 20 8- to 12-year-old children. The intra- and inter-examiner reproducibility expressed as weighted Kappa value amounted to 0.88 and 0.90 for the scoring of non-cavitated caries lesions according to ICDAS II criteria. The intra- and inter-examiner reproducibility values for sealants were 0.96 and 0.95 (Kappa).

Statistical analysis

The basic descriptive analysis of the oral health data was performed using SPSS 12.0 (SPSS Inc., Chicago, IL USA) and Excel 2000 (Microsoft Corporation, Redmond, WA, USA). Additional statistical analyses were necessary to investigate the effect of PFS on dental health: after thoroughly checking the complete data set, data from 15 patients had to be excluded because their first permanent molars were missing/had been extracted. The relationships between the dental health outcomes (sound, non-cavitated, decayed and filled pits and fissures) and the preventive effect of PFS as well as potential confounders (age, gender and immigrant background) were first substantiated by means of contingency tables and a chi-square test. Adjusted Poisson regression models were fitted to determine whether PFS were associated with better dental health outcomes. The results were expressed as the relative risk (RR) with 95% confidence intervals. SAS, version 9.1 (SAS Institute Inc., Cary, NC, USA) was used for the evaluations. The data interpretation should be made according to the following rules: A RR of 1 means there is no difference in risk between both groups, a RR of less than 1 means the event is less likely to occur in the sealant group than in the non-sealant group and a RR of greater than 1 means the event is more likely to occur in the sealant group than in the non-sealant group.

Results

The examined children (72.7%) showed no cavitations and fillings in their permanent dentition (DMFS=0); 31.3% of all 8- to 12-year-old children had a mixed dentition free of cavitations and filling (DMFS/dmfs=0). Only in 5.0% of the children were registered no cavitations and fillings as well as no non-cavitated caries lesions on the permanent molars (DMFS/dmfs=0 and ICDAS=0). The overall caries experience among the children corresponded to 1.0 (standard deviation±2.5) DMFS on average. The mean decayed/filled teeth (DFS) values amounted to 0.5 (±1.0) for the occlusal fissures, 0.2 (±0.6) for the palatal/buccal pits and 0.3 (±0.9) for the remaining teeth. Non-cavitated caries lesions were recorded as ICDAS II scores 1 to 4 on 1.8 (±1.6) occlusal fissures and on 1.5 (±1.4) palatal/buccal pits. Sealants were registered on 1.4 (±1.7) occlusal fissures and 0.4 (±0.9) palatal/buccal pits; 55.6% of the 8- to 12-year-old children had at least one sealed fissure or pit. The details of the sealant distribution in relation to age are presented in Fig. 1. Sealed molars (63.6%; mean 0.9) were scored as intact, while 36.4% (mean 0.5) showed a partial material loss.

The oral health parameters for children with any sealant treatment amounted to 1.7 (±2.6) dmft, 4.6 (±7.9) dmfs, 0.9 (±1.4) DMFT and 1.2 (±2.6) DMFS. In children without sealants were registered the following data: 2.3 (±2.9) dmft, 6.0 (±9.2) dmfs, 0.3 (±0.9) DMFT and 0.6 (±2.7) DMFS. A summary of the clinical findings for the pits and fissures of the first permanent molars in relation to the sealant status can be seen in Tables 1 and 2.

Comprehensive information about the children's dental health outcomes and their demographic characteristics are listed in Table 3. As demonstrated in Table 4, 12-year-old children were more likely to have fewer sound pits and fissures, more sealants and more decayed/filled pits and fissures compared to the younger children. Non-cavitated

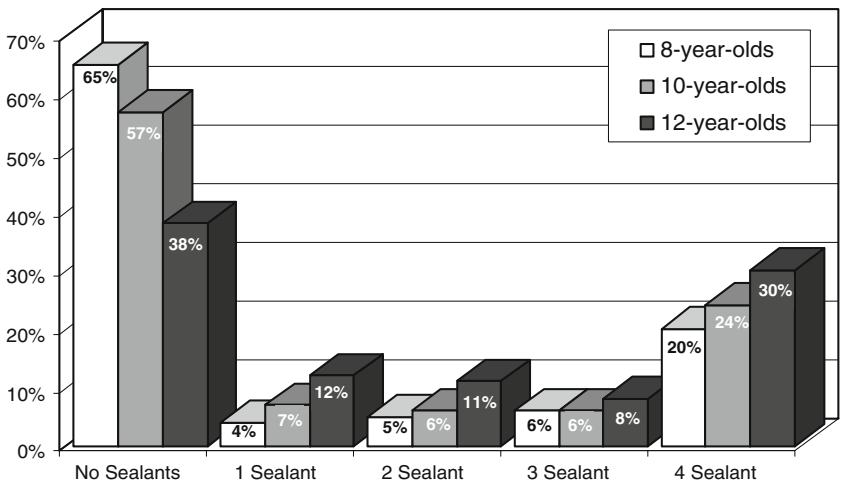

Fig. 1 Frequencies of fissure sealants in relation to the number of sealants and the age of the children

Table 1 Clinical records for pits and fissures of first permanent molars

N (%)	Sound	DS	MS	FS	Non-cavitated caries lesions	Intact sealants	Partial sealant loss	Σ
Children without any pit and fissure sealants (*n*=138)								
Number (%) of fissures	173 (32%)	13 (2%)	6 (1%)	6 (1%)	345 (64%)	–	–	543
Number (%) of pits	324 (60%)	11 (2%)	6 (1%)	6 (1%)	196 (36%)	–	–	543
Children with pit and fissure sealants (*n*=173)								
Number (%) of fissures	27 (4%)	13 (2%)[a]	5 (1%)	103 (16%)[b]	232 (34%)	278 (41%)	159 (23%)[c]	683
Number (%) of pits	263 (39%)	16 (2%)	5 (1%)	33 (5%)[d]	260 (38%)	95 (14%)	31 (5%)[e]	683

[a] Three cavitated surfaces were simultaneously scored

[b] Filled surfaces (22) were simultaneously scored with a non-cavitated caries lesion; one surface was registered with a partial sealant loss

[c] Partially sealed fissures (112) were simultaneously scored with a non-cavitated caries lesion

[d] Four filled surfaces were simultaneously scored with a non-cavitated caries lesion

[e] Partially sealed pits (16) were simultaneously scored with a non-cavitated caries lesion

Table 2 Clinical records for pits and fissures of first permanent molars in relation to age and sealant status

Mean (sd)	Children without pit and fissure sealants		Children with pit and fissure sealants		All children	
	Fissures	Pits	Fissures	Pits	Fissures	Pits
8- to 12-year-old children	*N*=138		*N*=173		*N*=311	
Sound	1.2 (1.6)*	2.3 (1.6)*	0.1 (0.4)*	1.5 (1.3)*	0.6 (1.2)	1.9 (1.5)
Sealants	–	–	2.5 (1.6)	0.7 (1.1)	1.4 (1.7)	0.4 (0.9)
DFS	0.2 (0.7)*	0.1 (0.5)*	0.7 (1.1)*	0.3 (0.7)*	0.5 (1.0)	0.2 (0.6)
DS	0.1 (0.4)	0.1 (0.3)	0.1 (0.3)	0.1 (0.4)	0.1 (0.4)	0.1 (0.3)
FS	0.1 (0.5)*	0.0 (0.3)*	0.6 (1.1)*	0.2 (0.6)*	0.4 (0.9)	0.1 (0.5)
Non-cavitated caries lesions	2.5 (1.6)*	1.5 (1.5)	1.3 (1.3)*	1.5 (1.3)	1.8 (1.6)	1.5 (1.4)
8-year-old children	*N*=83		*N*=59		*N*=142	
Sound	1.7 (1.6)*	2.7 (1.5)*	0.2 (0.6)*	2.0 (1.2)*	1.1 (1.5)	2.4 (1.4)
Sealants	–	–	2.7 (1.5)	0.6 (0.8)	1.1 (1.7)	0.2 (0.6)
DFS	0.0 (0.2)*	0.1 (0.3)	0.4 (0.8)*	0.2 (0.5)	0.2 (0.5)	0.1 (0.4)
DS	0.0 (0.2)	0.1 (0.3)	0.0 (0.2)	0.1 (0.4)	0.0 (0.2)	0.1 (0.3)
FS	0.0 (0.1)*	0.0 (0.0)	0.3 (0.8)*	0.1 (0.3)	0.1 (0.5)	0.0 (0.2)
Non-cavitated caries lesions	2.2 (1.6)*	1.2 (1.4)	1.1 (1.4)*	1.2 (1.2)	1.7 (1.6)	1.2 (1.3)
10-year-old children	*N*=26		*N*=28		*N*=54	
Sound	0.9 (1.4)*	2.2 (1.6)	0.1 (0.4)*	2.0 (1.5)	0.5 (1.1)	2.1 (1.5)
Sealants	–	–	2.5 (1.6)	0.8 (1.1)	1.3 (1.7)	0.4 (0.9)
DFS	0.2 (0.6)*	0.1 (0.3)	0.9 (1.4)*	0.4 (0.9)	0.5 (1.1)	0.2 (0.7)
DS	0.2 (0.5)	0.1 (0.3)	0.1 (0.3)	0.1 (0.4)	0.1 (0.4)	0.1 (0.3)
FS	0.0 (0.2)*	0.0 (0.0)	0.8 (1.3)*	0.3 (0.9)	0.4 (1.0)	0.1 (0.6)
Non-cavitated caries lesions	2.9 (1.4)*	1.7 (1.5)*	1.4 (1.3)*	1.0 (1.1)*	2.1 (1.5)	1.4 (1.3)
12-year-old children	*N*=29		*N*=86		*N*=115	
Sound	0.3 (0.9)*	1.2 (1.2)	0.1 (0.2)*	1.1 (1.2)	0.1 (0.5)	1.1 (1.2)
Sealants	–	–	2.4 (1.6)	0.8 (1.2)	1.8 (1.7)	0.6 (1.1)
DFS	0.7 (1.2)	0.3 (0.8)	0.9 (1.2)	0.3 (0.7)	0.8 (1.2)	0.3 (0.7)
DS	0.2 (0.7)	0.1 (0.4)	0.1 (0.3)	0.1 (0.3)	0.1 (0.5)	0.1 (0.3)
FS	0.4 (0.9)	0.2 (0.6)	0.8 (1.1)	0.2 (0.6)	0.7 (1.1)	0.2 (0.6)
Non-cavitated caries lesions	2.9 (1.6)*	2.2 (1.2)	1.5 (1.3)*	1.9 (1.3)	1.9 (1.5)	2.0 (1.3)

*$p<0.05$, chi-square test

Table 3 Children's dental health outcomes and demographic characteristics

Dental health outcomes		*n*	*N*	%
≥1 sound occlusal surface(s) on first permanent molars		78	296	26.4
Number of sealants on occlusal fissures on first permanent molars	1	22	296	7.4
	2	23	296	7.8
	3	18	296	6.1
	4	73	296	24.7
≥1 decayed occlusal surface(s) on first permanent molars		19	296	6.4
≥1 filled occlusal surface(s) on first permanent molars		60	296	20.3
≥1 non-cavitated occlusal caries lesion(s) on first permanent molars		207	296	69.9
≥1 sound palatal/buccal pit(s) on first permanent molars		220	296	74.3
Number of sealants on palatal/buccal pits on first permanent molars	1	38	296	12.8
	2	14	296	4.7
	3	14	296	4.7
	4	3	296	1.0
≥1 decayed palatal/buccal pit(s) on first permanent molars		22	296	7.4
≥1 filled palatal/buccal pit(s) on first permanent molars		24	296	8.1
≥1 palatal/buccal pit(s) with a non-cavitated caries lesion on first permanent molars		196	296	66.2
Age of the child	8	136	296	46.0
	10	49	296	16.6
	12	111	296	37.5
Gender	Male	157	296	53.0
Immigrant background		131	296	44.3

caries lesions were found most predominately in 8- and 12-year-old children.

Adjusted Poisson regression models were carried out to determine the effectiveness of pit and fissure sealants on dental health outcomes. The children were first put into two groups: (1) children with no fissure sealants on their first permanent molars and (2) children with at least one fissure sealant on their first permanent molars. The results show

Table 4 Associations between children's demographic characteristics and their dental health outcomes

Number of Cases (%)	Age			Immigrant background	Male
	8	10	12		
≥1 sound occlusal surface(s) on first permanent molars	57/78 (73.1%)	12/78 (15.4%)	9/78 (11.5%)*	29/78 (37.2%)*	32/78 (41.0%)
≥1 sealed occlusal surface(s) on first permanent molars	46/136 (33.8%)	20/136 (14.7%)	70/136 (51.5%)*	54/136 (39.7%)	75/136 (55.2%)
≥1 decayed occlusal surface(s) on first permanent molars	4/19 (21.1%)	4/19 (21.5%)	11/19 (57.9%)	11/19 (57.9%)	11/19 (57.9%)
≥1 filled occlusal surface(s) on first permanent molars	12/60 (20.0%)	9/60 (15.0%)	39/60 (65.0%)*	29/60 (48.3%)	28/60 (46.7%)
≥1 non-cavitated occlusal caries lesion(s) on first permanent molars	87/207 (42.0%)	38/207 (18.4%)	82/207 (39.6%)	99/207 (47.8%)	108/207 (52.2%)
≥1 sound palatal/buccal pit(s) on first permanent molars	118/220 (53.6%)	38/220 (17.3%)	64/220 (29.1%)*	91/220 (41.4%)	118/220 (46.4%)
≥1 sealed palatal/buccal pit(s) on first permanent molars	22/69 (31.8%)	11/69 (15.9%)	36/69 (52.3%)*	26/69 (37.7%)	40/69 (58.0%)
≥1 decayed palatal/buccal pit(s) on first permanent molars	9/22 (40.9%)	3/22 (13.6%)	10/22 (45.5%)	11/22 (50.0%)	11/22 (50.0%)
≥1 filled palatal/buccal pit(s) on first permanent molars	3/24 (12.5%)	2/24 (8.3%)	19/24 (79.2%)*	14/24 (58.3%)	12/24 (50.0%)
≥1 palatal/buccal pit(s) with a non-cavitated caries lesion on first permanent molars	73/196 (37.2%)	31/196 (15.8%)	92/196 (46.9%)*	85/196 (43.4%)	102/196 (48.0%)

*$p<0.05$, chi-square test

Table 5 Adjusted relative risk (RR) values for preventive sealant treatment in relation to sound, decayed and filled surfaces and those exhibiting non-cavitated caries lesions

	Adjusted RR (C.I.)			
	Sound	Non-cavitated lesions	Decay	Filling
≥1 sealed occlusal fissure(s) on first permanent molars	0.1 (0.1–0.2)	0.5 (0.4–0.6)	0.1 (0–0.4)	0.7 (0.5–1.1)
≥1 sealed palatal/buccal pit(s) on first permanent molars	0.6 (0.5–0.8)	0.6 (0.4–0.7)	0.6 (0.2–1.6)	2.0 (1.0–3.9)

that children who had at least one fissure sealant were less likely to have decayed fissures or fissures with non-cavitated lesions on their permanent molars (Table 5). Similar results were observed for pit sealants. However, children with at least one pit sealant on their first permanent molars also carried a higher probability of having fillings in pits compared to those who had no pit sealants at all (Table 5). We further categorised the children into additional groups: (1) children with no sealants on their first permanent molars; (2) children with one, two or three fissure sealants on their first permanent molars; and (3) children who had all of their occlusal fissures sealed. The results indicate that any sealant treatment—including up to three occlusal surfaces or all of them—improved dental health by reducing obvious decay (RR (C.I.)=0.2 (0.1–0.7) and 0.1 (0–0.6)) as well as the number of non-cavitated caries lesions (RR (C.I.)=0.3 (0.3–0.4) and 0.7 (0.6–0.9)).

Discussion

The overall caries experience of 1.0 DMFS recorded for the studied population in the EN district is in line with data obtained from the latest representative survey among children and adolescents nationwide [16]. This satisfying result seems to be of importance and clearly shows the preventive effect of the established school-based programme for children with a higher caries risk in the EN district North of Rhine-Westphalia. This assumption is further supported by the results of the tooth- and surface-related caries distribution. While 0.3 DFS were found on smooth surfaces, the majority of caries lesions was registered on the first permanent molars with their caries susceptible occlusal fissures (0.5 DFS) and palatal/buccal pits (0.2 DFS). Therefore, more efforts seem necessary to prevent the development and progression of caries lesions in pits and fissures, and the analysis of the results for non-cavitated lesions, decayed/cavitated surfaces, fillings and sealants further underlines this need.

The mean of 1.8 and 1.5 non-cavitated carious fissures and pits (Table 2) was also comparable to previous findings in the EN district [11, 17, 18]. Analysing the frequency rates found in this study, it stroke, however, that in all age groups, nearly 50% of the molars were affected by non-cavitated caries lesions. This percentage was, without exception, higher in the group of children without PFS than amongst those with PFS (Table 2).

Depending on age, the prevalence of children with PFS was between 35% and 62%. On average 1.1 (8-year-old children), 1.3 (10-year-old children) and 1.8 (12-year-old children) molars were sealed. Despite of prevalence increasing with age, the number of sealants has remained stagnant for the EN district during the last investigations. In 1999, an average of 1.4 fissure sealants was recorded in 10-year-old children [17]. This stagnation may partly be attributed to the fact that caries-risk patients (and/or their parents) do not take full advantage of PFS offered by the private dental practitioners as part of the nationwide preventive programme for 6- to 17-year-old children. Given the percentage of non-cavitated lesions combined with a relatively low number of PFS, consistent fissure sealing in children with a caries risk remains an important step in preventing a further increase of pits and fissure caries [1–8]. From a clinical point of view, this should happen soon after the complete eruption of the molars and before the first visual signs of a caries onset appear. The need to improve the quality of PFS in German populations [17, 19] remains in the light of documented retention levels—approximately one in three fissures and one in four pit sealants showed material loss, and beneath 51.6%/70.4% of the partially retained pit/fissure sealants a non-cavitated caries lesion was found. Therefore, more emphasis on maintaining the sealant quality should be placed by the dental practitioners.

We also analysed the preventive effects of PFS by fitting adjusted Poisson regression models. The results in Table 5 show that PFS constitute an effective measure to protect the sites on occlusal fissures and palatal/buccal pits most likely to be affected by caries amongst the high-risk population studied. Children with at least one PFS had a significantly lower adjusted RR of developing non-cavitated lesions and/or cavitations (DS) on the fissures and pits of their first permanent molars. Surprising at first was the fact that 8- and 10-year-old children with sealants had higher DFS and FS values for their pits and fissures than those without PFS (Table 2). This circumstance is further highlighted by the adjusted Poisson regression models (Table 5), where

children with at least one fissure or pit sealant had a RR of 0.7 (CI 0.5–1.1) and 2.0 (CI 1.0–3.9), respectively. While for occlusal fissures there is a negative correlation between the presence of sealants and caries-related fillings, a positive correlation does exist for the pits in view of the RR registered. This is remarkable because representative examinations have essentially proven a definite correlation between a low number of caries lesions and the presence of sealants [19]. Hence, this contradictory result should be more emphasised in future studies as it could speculate only about a limited caries preventive effect of sealants, a less frequent utilisation of preventive (and restorative) measurements by children without PFS and/or a possible (over-) treatment effect on (non-)cavitated caries lesions in children with PFS.

Based on our results (Tables 2 and 5), the null hypothesis under which children with PFS are showing a similar dental health compared with children without PFS was rejected. In general, it can be concluded from this population-based study that the sealant application is resulting in a more favourable dental health in children with PFS when analysing the site-specific data of occlusal fissures and palatal/buccal pits. Therefore, PFS are clearly indicated in caries-risk children. This recent finding is in line with the vast majority of guidelines on the use of PFS in children [1–8], but in contrast to previously published recommendations by Heyduck [9] and Heyduck et al. [10]. The high number of non-cavitated caries lesions shows furthermore the susceptibility of fissures and pits in connection with the studied population. Since the same findings were obtained in previous studies [11, 12, 18] it must be assumed that preventive care measures including PFS offered by private dental practitioners seem to be underused. Therefore, it should be discussed whether PFS can also be placed by dentists of the public health service as part of prevention schemes for caries-risk groups. School-based programmes, which include PFS, could be a way to reduce the high frequencies of non-cavitated caries lesions on pits and fissures. Such schemes should, without doubt, be accompanied by efforts to establish a tooth-friendly diet, better oral hygiene and professional fluoride applications as only the combination of these preventive measures provides the best protection against caries.

From a scientific point of view, it is recommended to carry on documenting and analysing the long-term success of preventive strategies aimed at caries-risk groups. This aim should be accompanied with observational longitudinal studies which taking into account non-cavitated lesions and PFS in order to gain detailed information about current and future caries trends. When further reflecting methodological limitations of cross-sectional epidemiological studies, e.g. missing information about caries (risk) diagnostics before a sealant placement, the non-availability of perfectly clear (contra-)indications for a sealant placement as well as the unknown sealing procedure etc., then appropriate designed randomised clinical trials should be planned to investigate the effectiveness of pit and fissure sealants in (non-)caries-risk patient under exclusion of all possible confounding factors and selection bias. Results from both study types will then provide detailed information about possible sealing strategies.

Conflict of interest The authors declare that they have no conflict of interest.

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