Prevalence and risk factors of erosive tooth wear in 3-6 year old German kindergarten children-A comparison between 2004/05 and 2014/15

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Abstract: OBJECTIVES The aims of this study were (1) to investigate prevalence, severity and distribution of erosive tooth wear in German kindergarten children aged 3-6 years in 2014/15 in comparison to an earlier survey from 2004/05 and (2) to identify and compare possible risk factors. METHODS 775 children aged 3-6 years from 27 kindergartens were examined in 2014/15 and compared to the data from 2004/05 (432 children/21 kindergartens). Erosive tooth wear was examined using the O'Sullivan-Index. Additionally, data were converted into the Basic Erosive Wear Examination (BEWE)-index. Information about dietary habits, chronic illness and oral hygiene practices were obtained by questionnaires. Statistical analyses were done by Chi(2)-, Mann-Whitney U Tests and regression analyses ($p<0.05$). RESULTS Compared to 2004/05 (31.3%) prevalence of erosive tooth wear was significantly increased in 2014/15 (45.4%). In 2004/05 and 2014/15, prevalence increased significantly with increasing age of the children: 3-year-olds: 22.5%/14.2%; 4-year-olds: 27.4%/32.9%; 5-year-olds: 30.5%/58.8%; 6-year-olds: 38.1%/71.7%. Children with erosive tooth wear presented more affected teeth and a higher severity of erosive tooth wear, respectively, in 2014/15 compared to 2004/05. The BEWE score sum was significantly higher in 2014/15 (3-year-olds: 3.4±2.1, 4-year-olds: 4.2±3.1, 5-year-olds: 4.6±2.9, 6-year-olds: 5.9±3.3) than in 2004/05 (3-year-olds: 2.0±1.2, 4-year-olds: 2.7±1.8, 5-year-olds: 2.7±2.4, 6-year-olds: 4.2±4.2). In 2014/15, age and male gender were significant with respect to the presence of erosive tooth wear. Severity of erosive tooth wear was dependent on the regular consumption of fruit juices and lemonade/coke. CONCLUSION The prevalence of erosive tooth wear in German kindergarten children has increased in the last ten years.

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Short title: Prevalence of erosive tooth wear in children

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Abstract

Objectives: The aims of this study were 1) to investigate prevalence, severity and distribution of erosive tooth wear in German kindergarten children aged 3-6 years in 2014/15 in comparison to an earlier survey from 2004/05 and 2) to identify and compare possible risk factors.

Methods: 775 children aged 3-6 years from 27 kindergartens were examined in 2014/15 and compared to the data from 2004/05 (432 children/21 kindergartens). Erosive tooth wear was examined using the O`Sullivan-Index. Additionally, data were converted into the Basic Erosive Wear Examination (BEWE)-index. Information about dietary habits, chronic illness and oral hygiene practices were obtained by questionnaires. Statistical analyses were done by Chi^2-, Mann-Whitney-U-Tests and regression analyses (p<0.05).

Results: Compared to 2004/05 (31.3%) prevalence of erosive tooth wear was significantly increased in 2014/15 (45.4%). In 2004/05 and 2014/15, prevalence increased significantly with increasing age of the children: 3-year-olds: 22.5%/14.2%; 4-year-olds: 27.4%/32.9%; 5-year-olds: 30.5%/58.8%; 6-year-olds: 38.1%/71.7%. Children with erosive tooth wear presented more affected teeth and a higher severity of erosive tooth wear, respectively, in 2014/15 compared to 2004/05. The BEWE score sum was significantly higher in 2014/15 (3-year-olds: 3.4±2.1, 4-year-olds: 4.2±3.1, 5-year-olds: 4.6±2.9, 6-year-olds: 5.9±3.3) than in 2004/05 (3-year-olds: 2.0±1.2, 4-year-olds: 2.7±1.8, 5-year-olds: 2.7±2.4, 6-year-olds: 4.2±4.2). In 2014/15, age and male gender were significant with respect to the presence of erosive tooth wear. Severity of erosive tooth wear was dependent on the regular consumption of fruit juices and lemonade/coke.

Conclusion: The prevalence of erosive tooth wear in German kindergarten children has increased in the last ten years.

Clinical Significance

The prevalence of erosive tooth wear in kindergarten children in the city of Göttingen/Germany has increased over the past decade, but the overall severity of erosive tooth wear is low. Dietary factors were associated with the severity of erosive tooth wear in the present survey.

Introduction

Erosive tooth wear is frequently seen in the primary and permanent dentition and seemed to increase over the last decades. Epidemiological studies have shown that up to 80% of children in the primary dentition and up to 100% of adolescents and adults in the permanent dentition present signs of erosive tooth wear (for review see [1]). However, prevalence data vary widely and are difficult to compare, not least as different scoring systems were used and different populations and number and sites of teeth were examined [1,2].

Thus, it is difficult to determine if the occurence and severity of erosive tooth wear really increased over time or if the condition is perceived more often, for instance due to a growing knowledge about erosive tooth wear.

Only few studies investigated the prevalence of erosive tooth wear in the primary dentition over time with the same methodological standards. Ganss et al. [3] analysed the prevalence and incidence of erosive tooth wear by pre-orthodontic study models and found that the percentage of subjects with at least one tooth exhibiting erosive tooth wear in the primary dentition increased from 52.2% in the time period 1977-1989 to 83.1% in 1990-1999. However, a recent study in Brazilian preschool children found very similar prevalences of erosive tooth wear when comparing data from 2008 (51.6%), 2010 (53.9%) and 2012 (51.2%) [4].

As data on prevalence changes are scarce, the purpose of this study was to compare prevalence, severity and distribution of erosive tooth wear in german kindergarten children aged 3-6 years in 2004/05 [5] and 2014/15 and to identify trends of this condition and investigate possible reasons for change.

The null hypotheses was that the prevalence of erosive tooth wear is not significantly changed within the past decade.

Methods

The present study was performed between December 2014 and May 2015 in the city of Göttingen, Germany, using the same methods and criteria as in the study performed in 2004/05 [5].

Ethical approval was given by the local ethics committee (08/11/14). Written consent was obtained from parents or legal guardians of the children before enrollment in the study. The study was conducted in accordance to the Declaration of Helsinki.

Sample population

All urban kindergartens (n = 62, approximately 2800 children) in Göttingen, Germany, were approached by the head teachers to participate in the study. Twenty-seven kindergartens agreed to participate and were involved in the study. From these kindergartens, 775 children (370 female, 405 male) aged 3-6 years were included in the study as they were allowed to participate (written consent) and cooperated at the day of examination.

Clinical examination

Examination of the children in the 2014/15 survey was conducted in the kindergartens with the child seated in the front of the examiner and using standardized light and dental mirrors. Erosive tooth wear was scored according to the O`Sullivan-Index [6] (as in the 2004/05 survey). Therefore, all teeth of the mouth were examined for site of erosion (A: labial or buccal only, B: lingual or palatinal only, C: occlusal or incisal only, D: labial and incisal/occlusal, E: lingual and incisal/occlusal, F: multi-surafce), severity (0: normal enamel, 1: matt appearance of the enamel surface with no loss of contour, 2: loss of enamel only/loss of surface contour, 3: loss of enamel with exposure or dentin/EDJ visible, 4: loss of enamel beyond EDJ, 5: loss of enamel and dentin with exposure of the pulp, 9: unable to assess) and area of surface affected („-": less than half of the surface affected, „+": more than half of the surface affected) given a three-digit score.

Generally, loss of surface contour appearing flat and shiny was defined as mechanical tooth wear (abrasion, attrition) and and was excluded from the analysis.

Additionally to the O`Sullivan-Index, the Basic Erosive Wear Examination (BEWE) [7] was used in n = 33 children to analyse if the conversion from the data of the O´Sullivan-Index [6] into the BEWE [7] (Table 1) is valid. BEWE-scores based on calculation from the data of the O`Sullivan-Index were compared to the pure BEWE data; weighted Cohens`s Kappa statistics amounted to 0.969 (inter-test reliability).

For the basic erosive wear examination (BEWE), all teeth are examined and the most severely affected surface (buccal/facial, occlusal, and lingual/palatal) of each tooth is recorded (0: no erosive tooth wear, 1: Initial loss of enamel surface texture, 2: Distinct defect, hard tissue loss less than 50% of the surface area, 3: hard tissue loss more than 50% of the surface; in score 2 and 3 dentin is often involved) given the score for the respective tooth. Each tooth is scored, and the highest score for a tooth surface gives the score for each sextant. The BEWE score sum is calculated by adding the sextant scores.

Dental examinations in 2014/15 were undertaken by a single examiner (CMP) who was intensively trained and calibrated by an experienced examiner (AW, single examiner in the 2004/05 survey). To validate the calibration process, inter-examiner reliability (examination of 53 children) and intra-examiner reliability (examination of 33 children) was assessed with Cohen`s Kappa statistics and amounted to 0.851 and 0.753, respectively.

Questionnaire

Questionnaires were given to and filled out by the parents/legal guardians along with the invitation letter and informed consent forms. The questionnaire consisted of a combination of open and close-ended questions regarding chronic illness related to gastric acid reflux or vomiting, erosion-related medications, dietary habits and oral hygiene habits [5].

Additionally, the leading teachers of each kindergarten were asked to fill out a questionnaire regarding dietary habits and oral hygiene measures in the institution.

Statistical analysis

Children were affected from erosive tooth wear when they had at least one tooth presenting signs of erosive tooth wear. Chi^2-tests were performed to compare the prevalence of erosive tooth wear in 2004/05 and 2014/15 and to test the influence of age and sex on erosive tooth wear. To analyse if the number of teeth affected from erosive tooth wear has increased, Mann-Whitney-U-test was applied (all tests based on the O`Sullivan-Index [6]).

To analyse if severity of erosive tooth wear (BEWE score sum) has increased from 2004/05 to 2014/15, Mann-Whitney-U-test was applied. Therefore, data were transferred from the O´Sullivan Index [6] into the BEWE scoring system [7] (Table 1) as the inter-test reliability showed a very high agreement (weighted Cohen`s Kappa: 0.969).

For the data of 2014/15, logistic regression analysis was performed to identify risk factors for erosive tooth wear; odds ratios for risk factors were calculated. Stepwise regression was applied to identify risk factors that influence the severity of erosive tooth wear (based on BEWE score sum).

Overall, a p-value < 0.05 was considered to indicate statistical significance.

Results

Prevalence, severity and distribution of erosive tooth wear

Compared to 2004/05 (31.3%) prevalence of erosive tooth wear in 3-6 year old children was significantly increased in 2014/15 (45.4%). Prevalence of erosive tooth wear differed significantly between 2014/15 and 2004/05 for 5- and 6-year old children, but not for 3- and 4-year old children. However, in both surveys (2004/05 and 2014/15), prevalence increased significantly with increasing age of the children: 3-year-olds: 27.5%/14.2%; 4-year-olds: 27.4%/32.9%;

5-year-olds: 29.8%/58.8%; 6-year-olds: 38.1%/71.7%; only primary teeth were affected. In both surveys, boys were more often affected from erosive tooth wear than girls, but this effect was significant only in 2014/15 (Table 2).

Children with erosive tooth wear presented more affected teeth and a higher severity of erosive tooth wear (BEWE score sum), respectively, in 2014/15 compared to 2004/05 (Table 3). Fifty-four of 135 children (40%) in 2004/05 and 200 of 352 children (56.8%) in 2014/15 exhibited at least one tooth with erosive tooth wear affecting dentin.

However, considering the risk levels of the BEWE [7], the majority of children present no (BEWE score sum less than or equal to 2, 2004/05: 84.5%, 2014/15: 66.7%) or a low risk (BEWE score sum between 9 and 13, 2004/05: 13.2%, 2014/15: 28.0%), while few children presented a medium (BEWE score sum between 9 and 13, 2004/05: 1.6%, 2014/15: 5.0%) or even a high risk (BEWE score sum 14 and over, 2004/05: 0.7%, 2014/15: 0.5%).

In Figure 1, the BEWE scores in primary teeth of the upper and lower jaws are presented.

In both surveys (2004/05 and 2014/15), erosive lesions were mostly located only on occlusal/incisal surfaces (primary molars: 75.8%/74.2%, incisors and canines: 52.2%/45.5%) or affected multiple surfaces (primary molars: 21.1%/13.6, incisors and canines: 11.9%/18.6%), while erosive tooth wear affecting only buccal (primary molars: 0.2%/0.2%, incisors and canines: 6.2%/0%) or palatal/lingual (primary molars: 0.2%/1.8%, incisors and canines: 0.1%/1.4%) surfaces was rarely seen. Forty percent (2004/05) or 25.9% (2014/15), respectively, of the erosively affected teeth showed tooth wear exposing dentin.

Risk factor analysis

While no significant risk factors could be identified in 2004/05, logistic regression analysis revealed that age (odds ratio: 2.57; 95% CI: 2.11 - 3.12) and gender (odd ratio male children: 1.77; 95% CI: 1.25 - 2.50) were significantly associated with the risk to develop erosive tooth wear in 2014/15 (p < 0.001).

Severity of erosive tooth wear in children affected from the condition increased with age (p < 0.001), and the regular (more frequently than once a week) intake of fruit juices (p = 0.048) or limonade/coke (p = 0.043). All other dietary factors and parameters regarding chronic illness, medication and oral hygiene measures were not significant with respect to the presence or severity of erosive tooth wear.

Discussion

The present study shows that prevalence of erosive tooth wear in German kindergarten children aged 3-6 years has increased over the last decade from 31.3% to 45.4%. In the present survey, children with erosive tooth wear presented more affected teeth and a higher severity of erosive tooth wear than in 2004/05. However, as in the 2004/05 survey, the prevalence of erosive tooth wear increased with increasing age of the children, and boys were more often affected from erosive tooth wear than girls. The latter observations are in accordance to previous studies showing that the prevalence of erosive tooth wear is age dependent [4,8,9] and more prevalent in boys than in girls [8,10].

However, although the prevalence increased over the last decade, it has to be noticed that the overall severity of erosive tooth wear is low. Considering that the BEWE sum scores correspond to certain risk levels [7], only very few children presented a cumulative score of 9 or higher indicating that the vast majority of the children has no or a a low risk for erosive tooth wear. This observation is corroborated by other studies, showing that erosive tooth wear in the primary dentition is rarely severe [8,11,12].

In both surveys, the O´Sullivan-Index was used to allow for direct comparison of the data. In 2014/15, the BEWE-index was additionally applied, as it is a very simple, standardized and validated index to score severity of erosion. However, to allow for a simple comparison of severity of erosive tooth wear, the index had to be applied retrospectively to the data from 2004/05. This approach is in accordance to a previous study in which the BEWE-index was

applied to previously collected data from studies using other indices than the BEWE [13]. As Cohen`s kappa revealed an almost perfect agreement between the pure and calculated BEWE, it seems reasonable to apply the BEWE-index retrospectively to the data from 2004/05.

Distribution of erosive tooth wear within the dentition was similar between 2004/05 and 2014/15, except that maxillary canines and first molars were more affected from erosive tooth wear than maxillary incisors in the recent compared to the first survey. However, distribution in the 2014/15 study is in good accordance to some previous studies showing that tooth wear is more common in maxillary than in mandibular teeth [8,12,14] and in occlusal/incisal than in buccal or lingual surfaces [8,9,15].

As for the clinical examination, the same questionnaire was used in 2004/05 and in 2014/15, taking into consideration that questionnaires completed by parents at home always have a risk of self-reporting bias. As socioeconomical aspects were not covered in the questionnaire of the first survey, they were also not considered in the present examination, although some studies have shown that different socioeconomical parameters might act as a significant risk factor for the development of erosive tooth wear in the primary dentition [12,16-18]. Taking these limitations into account, the 2014/15 survey found only age and gender to be significant with respect to the presence of erosive tooth wear. Severity of erosive tooth wear was dependent on age and the regular consumption of erosive beverages (juices, lemonade or coke). This observation is in accordance to other studies [8,10,17,19] and underlines the need for more preventive initiatives targeting diet and dietary habits to improve oral health in kindergarten children.

Overall, it has to be taken into account that despite a relatively high sample size in both surveys, some selection bias due high amount of kindergartens not willing to participate in the surveys (2004/05: 9 of 30, 2014/15: 35 of 62) can not be fully excluded.

In conclusion, the present study showed that prevalence of erosive tooth wear in German kindergarten children has increased over the past decade, while the overall severity of erosive

tooth wear is low. Dietary factors were associated with the severity of erosive tooth wear only in

the 2014/15 survey.

Conflict of interest

The authors declare that there is no conflict of interest.

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Figure caption

Figure 1: Percentage of primary teeth with erosive tooth wear in 2004/05 and 2014/15 according to the BEWE scores.
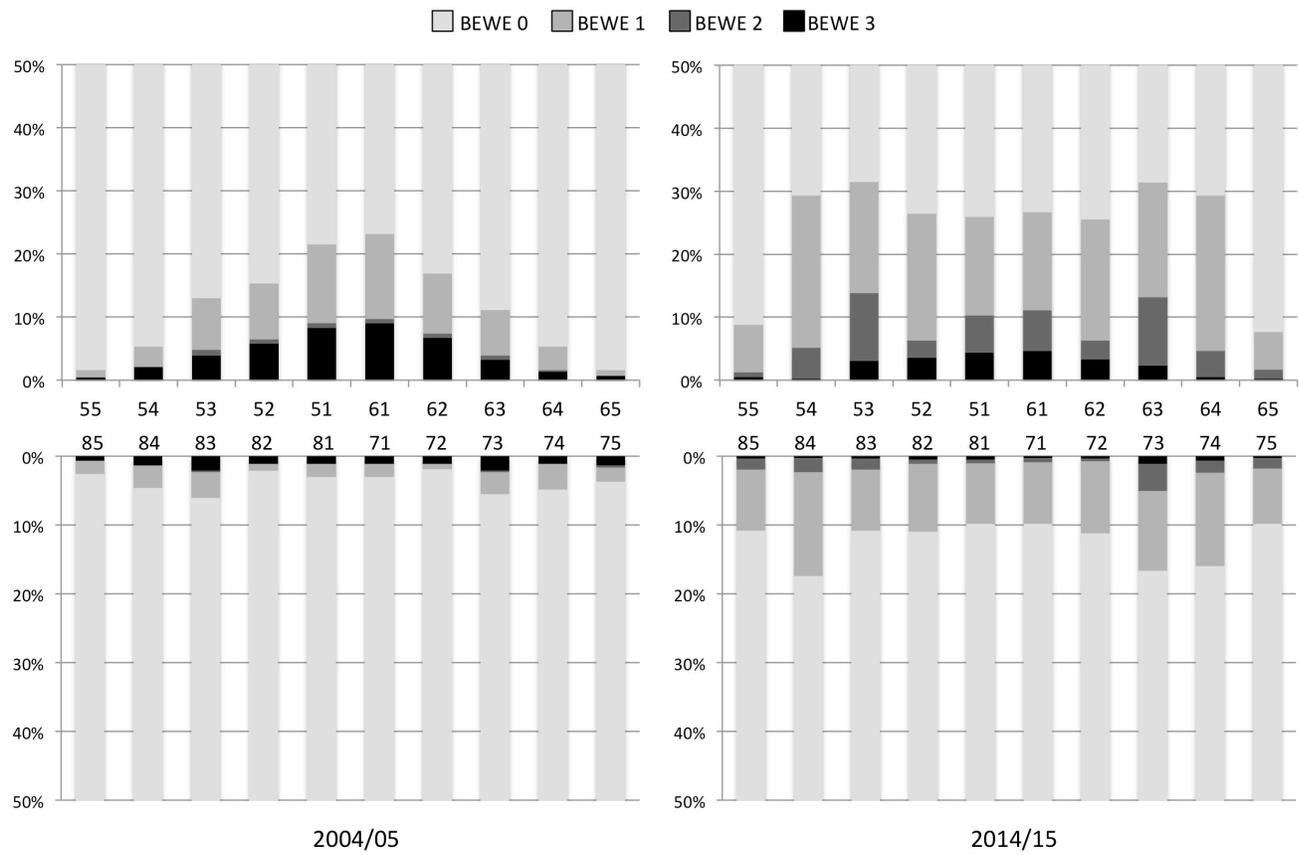
BEWE	O`Sullivan	
Score	Severity	Area of surface affected
0	0	-
1	1, 2	
2	3, 4, 5	Less than 50%
3	3, 4, 5	More than 50%

Table 1: Corresponding values of BEWE and O`Sullivan Index

Age	Number of children, n						Children affected from erosion, n (%)					
	2004/05			2014/15			2004/05			2014/15		
	total	female	male	total	female	male	total	female	male	total	female	male
3	40	21	19	134	63	71	9 (22.5)	3 (14.2)	6 (31.6)	19 (14.2)	5 (7.9)	14 (19.7)
4	117	58	59	246	118	128	32 (27.4)	14 (24.1)	18 (30.5)	81 (32.9)	31 (26.3)	50 (39.0)
5	141	51	90	243	117	126	43 (30.5)	13 (25.5)	30 (33.3)	143 (58.8)	65 (55.5)	78 (61.9)
6	134	66	68	152	72	80	51 (38.1)	24 (36.4)	27 (39.7)	109 (71.7)	49 (68.0)	60 (75.0)
total	432	196	236	775	370	405	135 (31.3)	54 (27.6)	81 (34.3)	352 (45.4)	150 (40.5)	202 (49.9%)

Table 2: Prevalence of erosive tooth wear in 3-6 year old german kindergarten children in 2004/05 and 2014/15

Age	Children affected from erosive tooth wear		BEWE score sum (mean ± standard deviation)		1- 5 teeth affected from erosive tooth wear, n (%)		6-10 teeth affected from erosive tooth wear, n (%)		11-15 teeth affected from erosive tooth wear, n (%)		>15 teeth affected from erosive tooth wear, n (%)	
	2004/05	2014/15	2004/05	2014/15	2004/05	2014/15	2004/05	2014/15	2004/05	2014/15	2004/05	2014/15
3	9	19	2.0 ± 1.2	3.4 ± 2.1	8 (88.9)	10 (52.6)	1 (11.1)	7 (36.8)	0	2 (10.5)	0	0
4	32	81	2.7 ± 1.8	4.2 ± 3.1	22 (68.8)	41 (50.6)	9 (28.1)	18 (22.2)	1 (3.1)	11 (13.6)	0	11 (13.6)
5	43	143	2.7 ± 2.4	4.6 ± 2.9	31 (72.1)	55 (38.5)	11 (25.6)	45 (31.5)	1 (2.3)	30 (21.0)	0	13 (9.1)
6	51	109	4.2 ± 4.2	5.9 ± 3.3	29 (56.9)	24 (22.0)	15 (29.4)	47 (43.1)	7 (13.7)	26 (23.9)	0	12 (11.0)
total	135	352	3.1 ± 3.0	5.0 ± 3.0	83 (61.5)	130 (36.9)	36 (26.7)	117 (33.2)	9 (6.7)	69 (19.6)	0	36 (10.2)

Table 3: Severity of erosive tooth wear (BEWE sum score) and number of affected teeth in children affected from erosive tooth wear