Iris Kraljevic[1]
Cornelia Filippi[2]
Andreas Filippi[3]

[1] Department of Reconstructive Dentistry and Temporomandibular Disorders, University Center for Dental Medicine Basel, University of Basel, Basel, Switzerland
[2] Children's Community Dental Service, University Center for Dental Medicine Basel, Basel, Switzerland
[3] Department of Oral Surgery, Oral Radiology and Oral Medicine, University Center for Dental Medicine Basel, University of Basel, Basel, Switzerland

CORRESPONDENCE
Prof. Dr. med. dent.
Andreas Filippi
Klinik für Zahnärztliche Chirurgie, -Radiologie, Mund- und Kieferheilkunde
UZB-Universitätszahnkliniken
Hebelstrasse 3
CH-4056 Basel
Tel. + 41 612 67 26 11
Fax + 41 612 67 26 07
E-Mail: andreas.filippi@unibas.ch

SWISS DENTAL JOURNAL SSO 127: 398–404 (2017)
Accepted for publication: 24 January 2017

Risk indicators of early childhood caries (ECC) in children with high treatment needs

KEYWORDS
Early childhood caries
Caries prevalence
Prevention
Risk factors
Switzerland

SUMMARY

Early childhood caries (ECC) represents a major health and economic problem worldwide. Its consequences such as early pain experience may affect the immediate and long-term quality of life of the child. In very young and uncooperative children the therapy of ECC is often viable only under general anesthesia. After treatment these affected children have a higher risk for future caries either soon thereafter, or later in life. The aim of the present study was to determine risk indicators and their correlation among children with high caries prevalence and high treatment needs, in order to facilitate the development of targeted prophylaxis programs that would reduce future occurrences of ECC or at least positively influence the outcome. For this purpose, between 2010 and 2014 the parents of these children (n=82) were interviewed in the University Children's Hospital in Basel (UKBB) prior to the children's treatment under general anesthesia. The standardized questionnaire included questions regarding the age of the child, the mother's country of origin, the oral hygiene, and the drinking habits of the child.

The analysis shows that the high mean dmft/dmfs values (dmft: 9.49 and dmfs: 26.35) correlated significantly with the geographic origin of the mother ($p<0.05$), the beginning of tooth brushing ($p<0.05$), lack of supervised tooth brushing ($p<0.01$), and nighttime consumption of sugar-sweetened beverages ($p<0.05$). In contrast, the duration of breastfeeding and prolonged use of a baby bottle (about 2.5 years) did not have a clear impact on high caries prevalence.

Introduction

In spite of new findings concerning its formation and the awareness of possible risk factors, *early childhood caries (ECC)* (Tinanoff 1998) still remains a serious health problem worldwide (Colak et al. 2013). In 2010 nine percent of the global population (621 million children) suffered from untreated caries in primary teeth (Kassebaum et al. 2015). Although the caries prevalence is declining worldwide, it still remains high in preschool children (Dye et al. 2007). At the same time, it is well known that appropriate prophylactic measures applied early in life can minimize the incidence of caries (Steiner et al. 2010; Waltimo et al. 2016). Thus in the Canton of Zurich, where collective prophylactic measures were implemented in schools in 1963, the caries prevalence of 8 to 14-year-olds has steadily declined. While in 1964 the average DMFT value of 14-year-olds was around 12.5, it declined to 1.31 in 2009, a reduction of 90% (Steiner et al. 2010).

In contrast, little is known about the caries experience in the primary dentition of Swiss infants and preschool children. Menghini et al. first described the caries prevalence in a representative sample of 2-year-olds in the city of Zurich (Switzerland) in 2007. The authors concluded that children of mothers born abroad exhibited a threefold higher number of carious lesions than children of Swiss mothers. In addition to this finding, the analysis of the parental interview revealed further risk indicators such as bad oral habits, frequent nighttime bottle-feeding, falling asleep with a baby bottle, and high consumption of sugar-sweetened beverages.

In a current Swiss study, Baggio et al. (2015) extended the risk indicators to include socioeconomic factors (education, profession, income). Socioeconomically disadvantaged children, regardless of Swiss or foreign origin, were more likely to have caries than less disadvantaged children.

A high caries burden may have a strong negative impact on the child's quality of life including early pain experience accompanied with reduced food intake, delayed speech development, and diminished self-confidence (Low et al. 1999; Petersen 2010; Gradella et al. 2011; Leal et al. 2012). In order to increase the child's quality of life and to avoid early trauma from painful dental treatments, oral rehabilitation under general anesthesia is in many cases the only option (Low et al. 1999; Filstrup et al. 2003). Although this treatment is effective, it has little influence on the manifestation of the disease, as the causes and underlying risk still remain (Schroth et al. 2007). The occurrence of new carious lesions within a few months is not uncommon and frequently necessitates a repeat treatment under general anesthesia (Almeida et al. 2000; Graves et al. 2004; Schroth et al. 2007; EzEldeen et al. 2015). It is proved conformity that children affected by ECC have an increased risk to develop caries in their permanent dentition (Li & Wang 2002; Peretz et al. 2003; Jordan et al. 2016). ECC is a multifactorial disease, whose development and progression are influenced by multiple factors. There are still gaps in our understanding of how the risk factors are interrelated and why some children are more affected by severe caries than others (Leong et al. 2013). In contrast to other chronic diseases, ECC is largely preventable with good oral health behaviors and healthy nutritional and drinking habits (Gussy et al. 2006; Wagner & Heinrich-Weltzien 2016).

The present investigation exclusively deals with children who are suffering from ECC and who had to undergo dental rehabilitation under general anesthesia due to their high treatment needs. The main focus of this study was to learn more about the relationships between the different risk indicators within this exposed group in order to positively influence the emergence or recurrence of carious lesions in these children as well as in other infants and preschool children by omitting one or more risk factors.

Materials and Methods

Between 2010 and 2014, data on these children were collected and evaluated at the Children's Community Dental Service in Basel as well as at the University Children's Hospital in Basel (UKBB). The present study included only children who, according to the definition of Drury et al. (1999), exhibited ECC and underwent dental treatment under general anesthesia within this time. A treatment under general anesthesia was performed when several treatment attempts failed or the child was unable to be treated due to its psycho-mental development. Children with systemic diseases, disabilities, or oncological history were excluded from data collection. The dental examination was completed according to WHO standards (World Health Organization 1997) by a pediatric dentist with a postgraduate education in pediatric dentistry at the Children's Community Dental Service in Basel.

For the assessment of the caries prevalence, the dmft/dmfs indices were determined based on cavitated lesions in primary teeth. In the primary dentition the maximum dmft value *(decayed/missing/filled teeth)* per child can be 20, the dmfs value *(decayed/missing/filled surfaces)* a maximum of 80.

In addition to the clinical examination on the day of the child's treatment under general anesthesia in the UKBB, the parents were interviewed in a standardized manner by the treating pediatric dentist. The questionnaire used for this purpose contained questions about the age of the child, the mother's country of origin and the child's tooth brushing and drinking behaviors (Tab. I).

The participation in the standardized interviews was voluntary. At least one parent had to be capable of verbally understanding the questions and predefined answers in order to complete the survey. The answer type was predominantly a single answer; in case of multiple answers, this was made clear in the question (Tab. I).

The dmft/dmfs caries index was compared with the parameters "geographic origin of the mother", "child's beginning of tooth brushing", "brushing frequency" and "drinking habits (type of beverage consumption, duration of breastfeeding and duration of baby bottle use)". The data were evaluated using the statistical program SPSS, Version 20 (IBM, Armonk, NY, USA). The variance analysis (one-way ANOVA; post hoc test according to Bonferroni) and the comparison test (t-test) were used. The significance level was set at $p \leq 0.05$.

The study was approved by the ethical review committee of Northwest- and Central Switzerland with a declaration of no-objection (UBE 1509).

Results

The evaluation included 82 standardized interviews. With 38 (46%) boys and 44 (54%) girls, patient genders were approximately equally distributed. The average age was 52.6 months (min. 11 months, max. 71 months, standard deviation [SD] 13.79). Of the 82 mothers in the sample, 30 were born in Switzerland (group CH), 10 in the European Union (group EU; EU member states 2014) and 42 outside the European Union (group N-EU) (Fig. 1).

Tab. I Standardized questions to the parents

Question	Answers at choice
Age?	
Gender?	1) boy 2) girl
Mother born in?	1) CH 2) EU 3) N-EU
When did tooth brushing begin?	1) from the first primary tooth 2) ≤1 year of age 3) >1 year of age
How often does the child clean their teeth?	1) does not clean 2) once 3) twice 4) three times
How often do the mother, father or others clean the teeth of the child?	1) does not clean 2) once 3) twice 4) three times
What does the child drink at daytime and at nighttime? (Indicate all beverages that the child receives)	1) nothing 2) water 3) water and sugar-sweetened beverages 4) sugar-sweetened beverages
For how long was the child nursed as a baby?	1) was not nursed 2) <6 months 3) ≤1 year 4) >1 year
For how long did the child receive a baby bottle?	1) did not receive one 2) <6 months 3) ≤1 year 4) >1 year

The mean dmft value was around 9.49 (SD 3.51), the average dmfs value around 26.35 (SD 15.18). There was no statistically significant difference in the caries index between the genders ($p>0.05$; t-test) (Tab. II). The mother's country of origin had a marked impact on the caries index (dmft/dmfs): the average dmft and dmfs values in the Swiss group (mean 8.2, SD 3.59 and mean 22.5, SD 12.89, respectively) were considerably lower than those in the non-European group (mean 10.38, SD 3.49 and mean 30.45, SD 17.07, respectively; $p<0.05$; one-way ANOVA; post hoc test according to Bonferroni). There was no statistically significant difference between the CH and EU groups ($p>0.05$; one-way ANOVA; post hoc test according to Bonferroni) (Fig. 2).

The beginning of tooth brushing likewise affected the dmft and dmfs values ($p<0.01$ and $p<0.05$, respectively; one-way ANOVA; post hoc test according to Bonferroni). If teeth were cleaned from the first erupted primary tooth on, the dmft value was around 7.9 (SD 3.4) and the dmfs value around 20.1 (SD 12.3). A few months later, the dmft value had risen to 10.4 (SD 4.0) and the dmfs to 31.8 (SD 18.2) (Fig. 2).

The N-EU group began tooth brushing considerably later than the two other groups ($p<0.05$; one-way ANOVA; post hoc test according to Bonferroni). The frequency of tooth brushing was not influenced by the mother's country of origin ($p>0.05$). Teeth of most children were brushed at least twice daily (by themselves or by another person).

A significant difference ($p<0.01$; t-test) was noted when children who cleaned by themselves were compared with children who received help with tooth brushing (supervised brushing). Eleven children cleaned by themselves; they exhibited dmf values of 12.0 (teeth) and 38.3 (surfaces). In children who received supervised tooth brushing (n=71), mean dmft and dmfs values were 9.1 and 24.5, respectively (Fig. 2). Supervised brushing was mainly carried out by the mother (mothers 82.9%, fathers 37.9%, others 18.3%; multiple rate was possible).

During the day, four children exclusively drank water and twelve solely sugar-sweetened beverages. The remaining 64 children consumed water and one or two additional drinks (milk and/or sugar-sweetened beverages). At nighttime, almost equal numbers of children drank only water (n=26) or only sugar-sweetened beverages (n=25) (Fig. 3). A comparison of these two groups showed that the nighttime consumption of sugar-sweetened beverages had a significant impact on the dmft/dmfs value ($p<0.05$; t-test) (Tab. II).

No difference, however, could be noted between children who were not breastfed (n=26) and those who were nursed for more than one year (n=21; $p>0.05$; t-test) (Tab. II). Breastfeeding lasted significantly longer in the N-EU group than in the

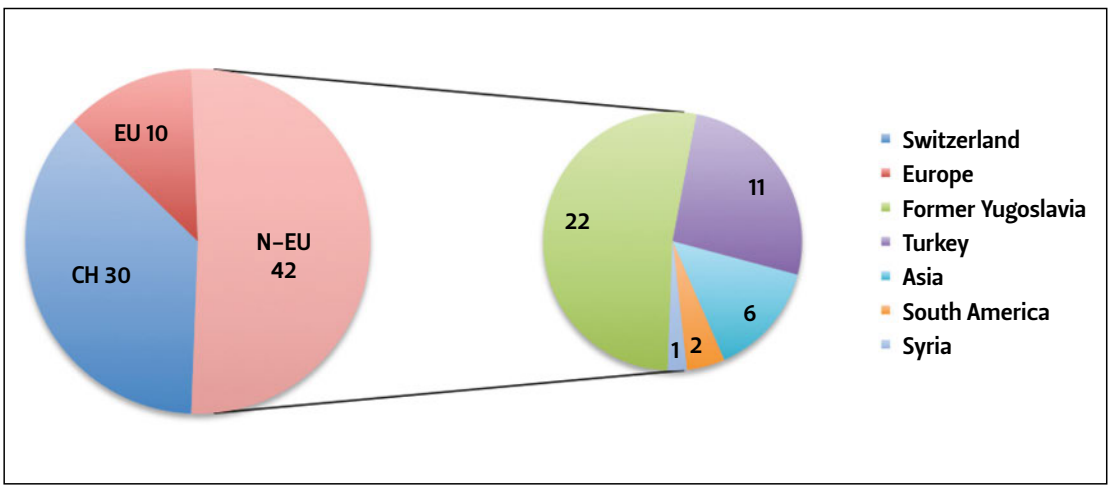

Fig. 1 Distribution of the mother's country of origin

Tab. II Dependence of dmft and dmfs values on gender and drinking behavior

	Children number	dmft mean	SD	t-Test p-value	dmfs mean	SD	t-Test p-value
Overall	**82**	**9.49**	**3.51**		**26.35**	**15.18**	
Gender							
Boys	38	9.53	3.72	**0.88**	26.63	14.75	**0.88**
Girls	44	9.43	3.36		26.11	15.71	
Beverage at night							
Water	26	8.27	3.28	**0.05**	21.50	13.05	**0.03**
Sugar-sweetened beverage	25	10.28	3.79		30.80	16.23	
Breastfeeding							
Not at all	26	9.81	2.71	**0.77**	25.15	12.17	**0.36**
Longer than 1 year	21	9.52	3.99		29.24	18.04	
Baby bottle							
Not at all	23	9.87	3.46	**0.67**	28.91	16.91	**0.44**
Longer than 1 year	55	9.49	3.58		25.95	14.72	

SD = Standard deviation

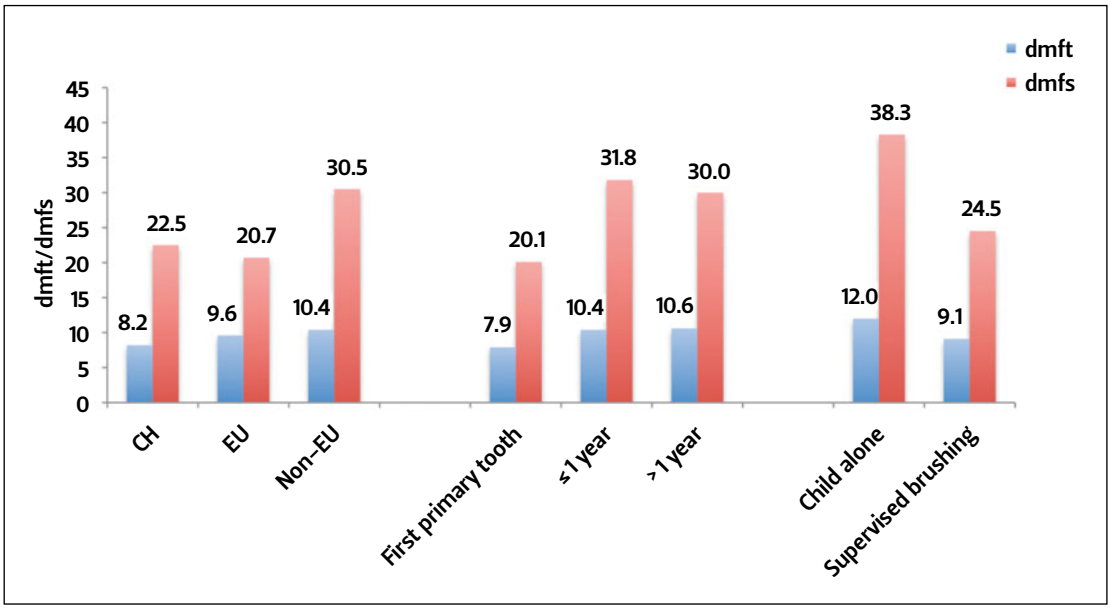

Fig. 2 Dependence of the dmft/dmfs values (arithmetic means) on the mother's country of origin, the beginning of tooth brushing, and the supervision of tooth brushing

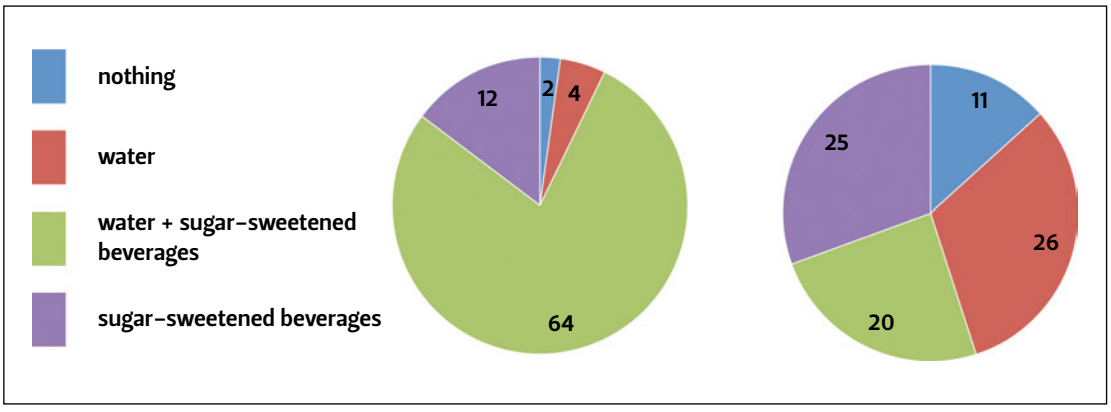

Fig. 3 Beverage consumption at daytime (left) and at nighttime (right)

Tab. III Results of the standardized interviews (by geographic origin)

Groups		Group CH	Group EU	Group N-EU	p*-value
Number		n=30 (%)	n=10 (%)	n=42 (%)	
Question					
	Gender				
1)	boys	15 (50%)	5 (50%)	18 (42.9%)	
2)	girls	15 (50%)	5 (50%)	24 (57.1%)	
	Beginning of tooth brushing				**0.12**
	unknown	1 (3.3%)	1 (10%)	7 (16.7%)	
1)	first primary tooth	20 (66.7%)	6 (60%)	7 (16.7%)	
2)	≤1 year	0 (0%)	2 (20.7%)	9 (21.4%)	
3)	>1 year	9 (30%)	1 (10%)	19 (45.2%)	
	How often does the child clean?				**0.15**
1)	does not clean	5 (16.7%)	1 (10%)	11 (26.2%)	
2)	once	3 (10%)	1 (10%)	8 (19%)	
3)	twice	10 (33.3%)	4 (40%)	13 (31%)	
4)	three times	12 (40%)	4 (40%)	10 (23.8%)	
	How long was the child nursed?				**0.04**
1)	was not nursed	13 (43.3%)	3 (30%)	10 (23.8%)	
2)	<6 months	11 (36.7%)	6 (60%)	10 (23.8%)	
3)	≤1 year	2 (6.7%)	0 (0%)	6 (14.3%)	
4)	>1 year	4 (13.3%)	1 (10%)	16 (38.1%)	
	How long did the child get a baby bottle?				**0.14**
1)	did not receive one	7 (23.3%)	1 (10%)	15 (35.7%)	
2)	<6 months	1 (3.3%)	0 (0%)	1 (2.4%)	
3)	≤1 year	0 (0%)	0 (0%)	2 (4.8%)	
4)	>1 year	22 (73.3%)	9 (90%)	24 (57.1%)	

* Calculation of p-values: analysis of variance (one-way ANOVA; post hoc test according to Bonferroni)

other two groups ($p<0.05$; one-way ANOVA; post hoc test according to Bonferroni) (Tab. III).

In the present sample, a baby bottle was used for an average period of 2.5 years (min. 0.2, max. 5.4 years; SD 1.29). With respect to the caries index (dmft/dmfs), no statistically significant difference ($p>0.05$; t-test) could be found between children who never received a bottle (n=23) and children who used one for more than one year (n=55). Irrespective of the mother's region of origin, the majority of children used the bottle beyond their first year (group CH: 73.3%, group EU: 90%, group N-EU: 57.1%).

Discussion

The results of the present study are based on a specific group, namely children with high treatment needs from the region of Basel. On average, half of the primary teeth and one third of the primary tooth surfaces were affected by caries.

The main goal of the study was to identify risk indicators, and their possible interrelationships, which favor the development of carious lesions. The evaluation of the standardized parental interviews revealed that in addition to factors already mentioned in previous studies from Switzerland (country of origin of the mother, high consumption of sugar-containing beverages), the beginning of tooth brushing and the lack of supervised brushing represent noteworthy risk indicators.

The late beginning of tooth brushing could explain the significantly higher caries values of children whose mothers were born outside the European Union. In contrast to the other groups (CH: 66.7%, EU: 60%), only 16.7% of the N-EU group brushed their teeth after the eruption of the first primary tooth. From Australia, Riggs et al. (2015) reported that the parents of Lebanese and Iraqi children were of the opinion that tooth brushing only makes sense after their child was enrolled in school, because by then it would be able to independently

brush his/her teeth. Cultural differences and parental attitudes play a crucial role in the development of oral hygiene and the achievement of a low dmft/dmfs value (Sarnat et al. 1984; Pine et al. 2004; Menghini et al. 2007; Begzati et al. 2014; Baggio et al. 2015).

Although it is not known at which stage plaque starts to become cariogenic (Löe 2000), Switzerland recommends brushing of the teeth once a day after the eruption of the first primary tooth, while the American Academy of Pediatric Dentistry (2016) advises brushing twice a day. Today it is assumed that thorough cleaning of the teeth twice a day keeps them free from plaque so that no caries can develop (Jepsen et al. 1998). Conceivably, the children in the present study indeed brushed their teeth twice to three times, but not very thoroughly. Eleven children from the sample cleaned their teeth alone. As a result, these children exhibited considerably more carious lesions than those who were supervised by a family member during brushing. This finding is consistent with the results of other investigations (Mazhari et al. 2007; Declerck et al. 2008).

The consumption of sugar-containing beverages is considered one of the main risk indicators for high caries prevalence in children, which corresponds with the results of this present evaluation (Grindefjord et al. 1995; Vanobbergen et al. 2001; Levy et al. 2003; Menghini et al. 2007, 2008; Leong et al. 2013; Sheiham & James 2015). In the present sample, only four children drank exclusively water during daytime. This, but above all the nighttime consumption of sugar-sweetened beverages or water combined with sweetened drinks (n=45), could explain the high dmf values.

The World Health Organization (WHO) in collaboration with the United Nations International Children's Emergency Fund (UNICEF) recommend breastfeeding of infants up to six months of age. If supplementary food is provided, nursing is even recommended until the age of two (WHO 2003). In a current systematic review it is emphasized that without a balanced diet and good oral hygiene, it is not impossible that nocturnal or frequent breastfeeding leads to ECC (Tham et al. 2015). If one can rely on the findings of our study, they further support the proposal of Tham et al. (2015) that breastfeeding is only a co-factor and is unlikely to lead to ECC when other influences are absent.

The same applies to the use of a baby bottle. The recommended duration of use is twelve months (Menghini et al. 2008). Although the majority of the children examined clearly exceeded this period, there was no statistically significant difference regarding the dmf values in the pertinent groups. This finding could be attributable to the fact that the content, the frequency and the time of use (nighttime/daytime) of the liquid supplied during the first two years of life was not known. Furthermore, it can be ruled out that this form of food intake, similar to breastfeeding, only leads to ECC if other risk factors (late beginning of tooth brushing, lack of supervised brushing) are present at the same time. However, no study results concerning this relationship are known to date.

Due to the limited number of participants, the validity of our findings is restricted. The low number of cases results from the voluntary participation and the demand for sufficient knowledge of the German language (at least one parent had to be able to understand and answer the questions). Among the parents who had agreed to participate in the interviews, some had to be excluded due to language barriers. Furthermore, as in many questionnaire surveys, a recall bias cannot be excluded. The authors tried to minimize it by predefining the answers, and in addition the treating dentist completed the form together with the parents. One must exercise some caution in generalizing from this study due to the absence of a caries-free control group. Nevertheless, our results obtained through a different study design confirm most findings of Menghini et al. (2007, 2008). This could be indicative of a causal relationship between ECC and the risk indicators identified in the latter studies.

Conclusions

The national origin of the mother, late beginning and manner of oral hygiene, as well as the nighttime consumption of sugar-sweetened beverages substantially influence the development of ECC. Given the fact that in 2013, 40% of babies in Switzerland were born to a foreign mother (Bundesamt für Statistik 2014), targeted educational programs should be initiated to deal with the deficits and needs of this risk group more effectively than it has been the case so far. The presented work provides the basis for further studies with the objective to make more precise statements regarding the impact of risk indicators of ECC.

Résumé

La carie précoce de l'enfant (CPE) représente au niveau mondial un problème majeur à la fois économique et de santé publique. Les conséquences de la CPE, telles qu'une expérience douloureuse précoce, peuvent péjorer la qualité de vie de l'enfant que ce soit immédiatement ou beaucoup plus tard. Quand il s'agit d'enfants très jeunes ou non compliants, l'anesthésie générale est souvent la seule possibilité de pouvoir les traiter. Une fois traités, ces enfants présentent encore un risque bien plus élevé de développer de futures caries à court, moyen et long terme.

Le but de cette étude est de déterminer des indicateurs de risque et leur corrélation parmi les enfants présentant une prévalence élevée de caries et un besoin élevé en soins. Le but étant de faciliter l'élaboration de programmes prophylactiques ciblés qui pourraient réduire à l'avenir l'occurrence de la CPE ou en influencer de manière positive ses conséquences.

Dans ce but, entre 2010 et 2014 à l'Hôpital Universitaire des Enfants de Bâle, des entretiens ont été conduits avec les parents d'enfants atteints de CPE (n=82), avant que ceux-ci ne soient traités sous anesthésie générale. Le questionnaire standardisé incluait l'âge de l'enfant, le pays d'origine de la mère, ainsi que les habitudes d'hygiène orale et alimentaires (boissons) de l'enfant.

Après analyse, il ressort que les valeurs moyennes élevées des indices dmft (9,49) et dmfs (26,35) sont fortement corrélées au pays d'origine de la mère ($p<0,05$), à l'âge auquel le brossage des dents a débuté ($p<0,05$), à l'absence d'un brossage des dents supervisé par les parents ($p<0,01$) et la consommation nocturne de boissons sucrées ($p<0,05$). En revanche la durée de la période d'allaitement et l'utilisation prolongée du biberon (environ 2,5 ans) n'ont pas d'impact clair sur la prévalence élevée de caries.

References

American Academy of Pediatric Dentistry: Policy on Early Childhood Caries (ECC): Classifications, Consequences, and Preventive Strategies. Pediatr Dent 38: 52–54 (2016)

Almeida A G, Roseman M M, Sheff M, Huntington N, Hughes C V: Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. Pediatr Dent 22: 302–306 (2000)

Baggio S, Abarca M, Bodenmann P, Gehri M, Madrid C: Early childhood caries in Switzerland: a marker of social inequalities. BMC Oral Health 15: 1–9 (2015)

Begzati A, Bytyci A, Mega K, Latifi-Xhemajli B, Berisha M: Mothers' behaviours and knowledge related to caries experience of their children. Oral Health Prev Dent 12: 133–140 (2014)

Bundesamt für Statistik: Statistisches Lexikon der Schweiz. Gesundheit von Müttern und Neugeborenen in der Migrationsbevölkerung. Gesundheit 14: 1–4 (2014)

Colak H, Dülgergil C T, Dalli M, Hamidi M M: Early childhood caries update: A review of causes, diagnoses and treatments. J Nat Sci Biol Med 4: 29–38 (2013)

Declerck D, Leroy R, Martens L, Lesaffre E, Garcia-Zattera M J, Vanden Broucke S, Debyser M, Hoppenbrouwers K: Factors associated with prevalence and severity of caries experience in preschool children. Community Dent Oral Epidemiol 36: 168–178 (2008)

Drury T F, Horowitz A M, Ismail A I, Maertens M P, Rozier R G, Selwitz R H: Diagnosing and reporting early childhood caries for research purposes. J Public Health Dent 59: 192–197 (1999)

Dye B A, Tan S, Smith V, Lewis B G, Barker L K, Thornton-Evans G, Eke P I, Beltran-Aguilar E D, Horowitz A M, Li C H: Trends in oral health status: United States, 1988–1994 and 1999–2004. Vital Health Stat 11: 1–92 (2007)

EzEldeen M, Gizani S, Declerck D: Long-term outcome of oral health in patients with early childhood caries treated under general anaesthesia. Eur Arch Paediatr Dent 16: 333–340 (2015)

Filstrup S L, Briskie D, Da Fonseca M, Lawrence L, Wandera A, Inglehart M R: Early childhood caries and quality of life: child and parent perspectives. Pediatr Dent 25: 431–440 (2003)

Gradella C M, Bernabe E, Bönecker M, Oliveira L B: Caries prevalence and severity, and quality of life in Brazilian 2-to 4-year-old children. Community Dent Oral Epidemiol 39: 498–504 (2011)

Graves C E, Berkowitz R J, Proskin H M, Chase I, Weinstein P, Billings R: Clinical outcomes for early childhood caries: influence of aggressive dental surgery. J Dent Child 71: 114–117 (2004)

Grindefjord M, Dahllöf G, Nilsson B, Modeer T: Prediction of dental caries development in 1-year-old children. Caries Res 29: 343–348 (1995)

Gussy M G, Waters E, Kilpatrick N M: A qualitative study exploring barriers to a model of shared care for pre-school children's oral health. Br Dent J 12: 165–170 (2006)

Jepsen S: The role of manual toothbrushes in effective plaque control: Advantages and limitations. In: Lang N P, Attström R, Löe H (eds). Proceedings of the European Workshop on Mechanical Plaque Control. Quintessenz, Berlin, pp 121–137 (1998)

Jordan A R, Becker N, Jöhren H P, Zimmer S: Early childhood caries and caries experience in permanent dentition: A 15-year cohort study. Swiss Dent J 126: 120–125 (2016)

Kassebaum N J, Bernabe E, Dahiya M, Bhandari B, Murray C J, Marcenes W: Global burden of untreated caries: a systematic review and metaregression. J Dent Res 94: 650–658 (2015)

Leal S C, Bronkhorst E M, Fan M, Frencken J E: Untreated cavitated dentine lesions: impact on children's quality of life. Caries Res 46: 102–106 (2012)

Leong P M, Gussy M G, Barrow S Y, de Silva-Sanigorski A, Waters E: A systematic review of risk factors during first year of life for early childhood caries. Int J Paediatr Dent 23: 235–250 (2013)

Levy S M, Warren J J, Broffitt B, Hillis S L, Kanellis M J: Fluoride, beverages and dental caries in the primary dentition. Caries Res 37: 157–165 (2003)

Li Y, Wang W: Predicting caries in permanent teeth from caries in primary teeth: an eight-year cohort study. J Dent Res 81: 561–566 (2002)

Löe H: Oral hygiene in the prevention of caries and periodontal disease. Int Dent J 50: 129–139 (2000)

Low W, Tan S, Schwartz S: The effect of severe caries on the quality of life in young children. Pediatr Dent 21: 325–326 (1999)

Mazhari F, Talebi M, Zoghi M: Prevalence of early childhood caries and its risk factors in 6–60 months old children in Quchan. Dent Res J 4: 96–101 (2007)

Menghini G, Steiner M: Orale Gesundheit in der Schweiz: Stand 2006. Schweizerisches Gesundheitsobservatorium (obsan) 26: 1–34 (2007)

Menghini G, Steiner M, Imfeld T: Early childhood caries – facts and prevention. Ther Umsch 65: 75–82 (2008)

Peretz B, Ram D, Azo E, Efrat Y: Preschool caries as an indicator of future caries: a longitudinal study. Pediatr Dent 25: 114–118 (2003)

Petersen P E: Improvement of global oral health – the leadership role of the World Health Organization. Community Dent Health 27: 194–198 (2010)

Pine C M, Adair P M, Nicoll A D, Burnside G, Petersen P E, Beighton D, Gillett A, Anderson R, Anwar S, Brailsford S, Broukal Z, Chestnutt I G, Declerck D, Ping F X, Ferro R, Freeman R, Gugushe T, Harris R, Lin B, Lo E C, Maupome G, Moola M H, Naidoo S, Ramos-Gomez F, Samaranayake L P, Shahid S, Skeie M S, Splieth C, Sutton B K, Soo T C, Whelton H: International comparisons of health inequalities in childhood dental caries. Community Dent Health 21: 121–130 (2004)

Riggs E, Gibbs L, Kilpatrick N, Gussy M, van Gemert C, Ali S, Waters E: Breaking down the barriers: a qualitative study to understand child oral health in refugee and migrant communities in Australia. Ethn Health 20: 241–257 (2015)

Sarnat H, Kagan A, Raviv A: The relation between mothers' attitude toward dentistry and oral status of their children. Pediatr Dent 6: 128–131 (1984)

Schroth R J, Smith W F: A review of repeat general anesthesia for pediatric dental surgery in Alberta, Canada. Pediatr Dent 29: 480–487 (2007)

Sheiham A, James W P: Diet and dental caries: the pivotal role of free sugars reemphasized. J Dent Res 94: 1341–1347 (2015)

Steiner M, Menghini G, Marthaler T M, Imfeld T: Changes in dental caries in Zurich school-children over a period of 45 years. Schweiz Monatsschr Zahnmed 120: 1084–1104 (2010)

Tham R, Bowatte G, Dharmage S C, Tan D J, Lau M X, Dai X, Allen K J, Lodge C J: Breastfeeding and the risk of dental caries: a systematic review and meta-analysis. Acta Paediatr 104: 62–84 (2015)

Tinanoff N: Introduction to the Early Childhood Caries Conference: initial description and current understanding. Community Dent Oral Epidemiol 26: 5–7 (1998)

Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D: Assessing risk indicators for dental caries in the primary dentition. Community Dent Oral Epidemiol 29: 424–434 (2001)

Wagner Y, Heinrich-Weltzien R: Evaluation of a regional German interdisciplinary oral health program for children from birth to 5 years of age. Clin Oral Investig doi: 10.1007/s00784-016-1781-8 (2016)

Waltimo T, Menghini G, Weber C, Kulik E M, Schild S, Meyer J: Caries experience in 7-, 12-, and 15-year-old schoolchildren in the canton of Basel-Landschaft, Switzerland, from 1992 to 2011. Community Dent Oral Epidemiol 44: 201–208 (2016)

World Health Organization: Oral Health Surveys: Basic Methods. 4th ed. Geneva (1997)

World Health Organization, UNICEF: Global strategy for infant and young child feeding (2003). Available at: www.who.int/nutrition/publications/infantfeeding/9241562218/en/