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Respiratory diseases are associated with molar-incisor hypomineralizations

Results from a long-term prospective cohort study

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SUMMARY
The objective of our study was to evaluate the association of molar-incisor hypomineralizations (MIHs) with prospectively collected potential causative factors from the first 4 years of life, *e.g.* respiratory diseases, breastfeeding, maternal smoking and parental education. A total of 692 children (10 years old) from the GINI birth cohort study participated. The dental examination included the registration of enamel hypomineralizations (EHs) according to the EAPD criteria. Children with EH were sub-categorized into those with at least one EH (MIH/1), those with a minimum of one EH on at least one first permanent molar (MIH/2) and those with EH on at least one first permanent molar and a permanent incisor (MIH/3). All relationships between causative factors and caries or MIH were evaluated using simple and multiple logistic regression analyses. EHs were observed in 37.9% (MIH/1), 14.7% (MIH/2) and 9.2% (MIH/3) of all subjects. After adjustment for confounding factors, 10-year-old children with at least one episode of respiratory disease had a significantly higher risk (2.48 times, adjusted OR) for the development of MIH/3. In case of breastfeeding, a non-significant association was observed. None of the tested factors was associated with either MIH/1 or MIH/2. Early respiratory diseases seem to be directly or indirectly related to MIH/3 only. The role of (systemic) medications used for treatment of these diseases needs to be investigated in future studies.

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Introduction

The etiological factors of molar-incisor hypomineralizations (MIHs) have not yet been clarified and there is insufficient evidence in literature about possible (co)factors that are causing these prevalent demarcated enamel defects (Crombie et al. 2009, Alaluusua et al. 2010). Numerous etiological factors have been evaluated in the past, but there is no long-term prospective epidemiological study published so far that includes a collection of comprehensive medical, nutritional, behavioral, socioeconomic, environmental and/or genetic information. Therefore, the recent discussion about causative factors for these enamel hypomineralizations (EH) is often speculative and prospectively designed studies are urgently required. According to this need, we evaluated the association of prospectively collected medical, nutritional and behavioral data from participants of the ongoing GINI (German Infant Nutritional Intervention) plus birth cohort study in the metropolitan area of Munich, Germany (von Berg et al. 2008, Rückinger et al. 2010) with the presence of MIH. Specifically, we aimed to assess the association of possible etiological factors from the first 4 years of life – early respiratory diseases, breastfeeding as well as maternal smoking and parental education as indicators of socioeconomic status – with the later presence of MIH in permanent teeth at the age of 10 years. The null hypothesis to be tested was that there is no association between the selected factors and the occurrence of MIH in the permanent dentition at the age of 10 years.

Materials and methods

Study population

The GINI plus study is an ongoing birth cohort study initiated to prospectively investigate the influence of nutrition intervention during infancy, air pollution and genetics on the development of allergies. Between September 1995 and July 1998, approximately 10,700 mothers were contacted in the obstetric clinics in Munich and Wesel, Germany, to participate in the GINI plus study with their healthy newborns. Nearly 56% of them accepted the study protocol; so a total of 5,991 healthy full-term newborns were recruited at baseline. The exclusion criteria were severe acquired or congenital diseases, pregnancy of <37 gestational weeks, birth weight <2,500 g, or parents unable to complete the questionnaire. Group assignment was furthermore based on family history of allergy and willingness to participate in a randomized clinical trial. After recruiting the newborns, the cohort was separated into an intervention (n=2,252) and a non-intervention group (n=3,739). The intervention group received nutritional advice promoting breastfeeding for at least 4 months and participated in a randomized trial on the effect of hydrolyzed formula *versus* conventional cow's milk formula in preventing allergies (in the control group). Children were followed up at the ages of 4 weeks, 3 months, 6 months, 1 year, 2 years, 3 years, 4 years, 6 years and 10 years. At each follow-up visit, all children were clinically examined by a pediatrician and the parents completed several age-related questionnaires regarding medical, nutritional, behavioral and socioeconomic issues. Respiratory diseases such as asthma, bronchitis and pneumonia, in addition to indicators for a broader spectrum of children's diseases, *e.g.* infections (otitis media, chicken pox, tertian fever etc.), were recorded from birth onwards. Details of the study population and protocols have been described elsewhere (von Berg et al. 2008, Filipiak et al. 2007, Morgenstern et al. 2007 and 2008, Heinrich et al. 2012).

At the 10-year follow-up visit, a dental examination was included to collect information on the oral health status. Between December 2005 and April 2007, 692 children (84.4% of all eligible children, average age 10.2 years, 358 females and 334 males) were evaluated after written consent to a dental examination was obtained from their guardians. The GINI plus protocol was approved by the local ethics committee (Bavarian General Medical Council), and written consent was obtained from all participating families.

Dental examination

Prior to the clinical examination, all participants brushed their teeth. A halogen lamp was used to illuminate the oral cavity (Ri-Magic, Rudolf Riester GmbH, Jungingen, Germany), a blunt CPI probe (CP-11.5B6, Hu-Friedy, Chicago, IL, USA), a dental mirror and cotton rolls for drying teeth were used to improve the clinical detection and diagnosis of non-cavitated carious lesions as well as EH. The caries status according to the WHO standards (WHO 1997) was determined using the tooth- and surface-related DMF index for the permanent dentition (DMFT/S). Non-cavitated carious lesions were scored using the universal visual scoring system (UniViSS; Kühnisch et al. 2009 and 2011). First visible signs, established lesions, enamel breakdowns and microcavities were summarized as non-cavitated carious lesions. In addition to the caries status, each child was carefully screened for EH – defined as white, creamy-white or yellow to brownish demarcated opacities, teeth with enamel disintegration, and atypical restorations – according to the clinical criteria of the European Academy of Paediatric Dentistry (EAPD, Weerheijm et al. 2003, Lygidakis et al. 2010). In general, possible EHs with a diameter <1 mm were not documented (Lygidakis et al. 2010). Other enamel disturbances, *e.g.* hypoplastic defects, diffuse opacities which indicate fluorotic enamel, amelogenesis imperfecta and dentinogenesis imperfecta, were distinguished from demarcated EH and were not scored as MIH or caries. In accordance with the registration of the DMF index, all permanent teeth as well as surfaces were screened carefully for the presence of EH. In the case of a positive finding, the corresponding score was documented for the related surface.

Each child was investigated at the designated appointment by one of three calibrated dentists (JK, DM or CN). The weighted Kappa values for the intra- and interexaminer reproducibility were good to excellent and can be found elsewhere (Heitmüller et al. 2012)

Statistical analysis

All dental health data were entered into an SQL database (Access 2003, Microsoft Corporation, Redmond, WA, USA) and then transferred into an Excel sheet (Excel 2003, Microsoft Corporation, Redmond, WA, USA). The descriptive and explorative data analysis was performed with Microsoft Excel 2003 and R (www.r-projekt.org).

The descriptive analysis comprised the calculation of caries prevalence, DMFT/S mean values and standard deviations (SD) as well as means and standard deviations for non-cavitated carious lesions. The analysis of the EH data included primarily the assessment of the distribution pattern in the permanent dentition, which had proved successful in an earlier investigation (Kühnisch et al. 2012). All children with a minimum of one hypomineralized tooth according to the clinical criteria of the EAPD (Weerheijm et al. 2003, Lygidakis et al. 2010) were charac-

terized using the formula: MIH/1 = 1–28 permanent teeth. Otherwise, children were scored as free of EH. In the recently published best clinical practice guidelines, the well-accepted EAPD definition was confirmed to diagnose children with MIH if "at least one first permanent molar is affected" (Lygidakis et al. 2010). Simultaneously, the permanent incisors can be affected or not (Lygidakis et al. 2010). This group of children was designated as having a MIH/2 in the present report using the formula: MIH/2 = 1–4 permanent first molars. In an additional category, children with EH on permanent molars and incisors were classified as those with a MIH/3. This category is in line with the first published EAPD definition from 2003 to determine the disease in "one or more of the four permanent first molars, as well as any associated and affected incisors" (Weerheijm et al. 2003). The formula for identification of those children was: MIH/3 = 1–4 permanent first molars AND 1–8 permanent incisors.

According to the main aim of this study, the prospectively collected health data from the first 4 years of life were evaluated for a correlation with the recorded dental health outcomes in the permanent dentition at the age of 10. The relationship between the potential risk factors and the presence of caries (DMF) and MIH (MIH/1, MIH/2, MIH/3) was analyzed using simple and multiple logistic regression analysis. The results are presented as unadjusted odds ratios (uOR), adjusted odds ratios (aOR), their 95% confidence intervals (95%CI) and the corresponding P-values (P).

Results

No obvious decay in the permanent dentition (DMF=0) was found in 79.9% (n=554) of the examined 10-year-old children. But only 40.4% (n=280) of all children had a permanent dentition free of decay, (non-)cavitated carious lesions and caries-associated restorations (DMF/UniViSS=0). The mean (SD) caries experience among the children was 0.4 (0.9) DMFT and 0.4 (1.1) DMFS. The mean number (SD) of non-cavitated carious lesions amounted to 1.3 (1.6) teeth and 1.8 (2.5) surfaces per child.

In 37.9% of all participants, at least one EH in the permanent dentition was detected (MIH/1). A total of 14.7% (n=102) of the study population was identified as having a MIH/2, and 9.2% (n=64) of all 10-year-old children were classified with a MIH/3.

Crude associations and unadjusted associations between potential risk factors and caries or MIH are shown in Tables I and II. After adjustment for gender, intervention status and maternal age at birth, 10-year-old children with at least one episode of respiratory disease within the first 4 years of life had a 2.48 times higher risk (aOR) for the development of MIH/3 (Tab. III). An aOR of 2.33 was calculated for the relationship between breastfeeding and the occurrence of MIH/3; but this association was not significant (Tab. III). An increased risk to get classified as MIH/3 was also observed for 10-year-old children whose mothers smoked during pregnancy (aOR 1.86), but this association did not reach statistical significance. Parental education level and the clinical presence of MIH (MIH/1, MIH/2, MIH/3) were not associated. Furthermore, no significant associations were found between the investigated causative factors and the appearance of MIH/1 and MIH/2.

Interestingly, maternal smoking during pregnancy as an indicator of socioeconomic status significantly increased the risk of having caries (aOR 1.85). The same tendency was found for a lower level of parental education, but this association was not revealed as statistically significant. Respiratory diseases within the first 4 years of life did not have any impact on the appearance of caries-associated cavities and/or fillings.

Discussion

To the authors' knowledge, this is the first study that has collected prospective data from birth onwards and analyzed the correlation of this with the presence of MIH in the permanent dentition at the age of 10. Another advantage of the present study was that most of the participants were classified as low caries risk. This was indicated by the low caries experience of 0.4 DMFT/S. Due to the low DMF value an unambiguous clinical examination for EH/MIH was possible, especially on permanent molars, reinforcing the value of the present study.

Another unique aspect of this study is the meticulous recording of EH on all teeth, which was recently recommended in an EAPD policy document (Lygidakis et al. 2010). This aspect led to new insights regarding the distribution pattern of EH in the permanent dentition when viewing the number of children that were classified as MIH/1, MIH/2 or MIH/3. However, a large proportion of children could not be allocated to the MIH/2 and MIH/3 group as the presence of EH was restricted to one or more permanent molar(s) *or* incisor(s) (Kühnisch et al. 2012). With respect to this finding, it was concluded that EH can be observed with a more variable distribution pattern in contrast to widely held views. This situation is furthermore complicated by the fact that EHs are observable also in primary teeth, premolars and permanent canines (Lygidakis et al. 2010, Kühnisch et al. 2012, Lunardelli & Peres 2005, Elfrink et al. 2008, Koch & Reis 2010). Knowing well the impact of an accurate determination of the clinical phenotype on the outcome of association studies, it is obvious that more fundamental research regarding the distribution pattern is needed (Chawla, et al. 2008, Lygidakis et al. 2010, Kühnisch et al. 2012).

The major finding of our study was a significant association between respiratory diseases in the first 4 years of life and the appearance of MIH/3 (aOR 2.48, 95%CI 1.35–4.56, Tab. III) on the basis of a prospectively designed cohort study. This result confirms previously published findings from cross-sectional studies, which documented that children's (respiratory) diseases were related to the presence of EH/MIH (van Amerongen & Kreulen 1995, Rugg-Gunn et al. 1998, Jälevik et al. 2001, Beentjes et al. 2002, Tapias-Ledesma et al. 2003, Laisi et al. 2009, Arrow 2009). Positive associations between asthma, pneumonia, upper respiratory infections, otitis media and the presence of MIH were found in 8-year-old children (n=516) from Sweden (Jälevik et al. 2001). In 10-year-old children (n=45) from the Amsterdam area (The Netherlands), otitis media, pneumonia and high fever were related to the appearance of EH (Beentjes et al. 2002). Due to the infectious character of several respiratory diseases, *e.g.* bronchitis, pneumonia and croup, it should be discussed whether the illness itself or the corresponding (systemic) medication act as the primary influencing factor for the development of EH in teeth. This aspect was investigated by a Finnish working group in a recently published report (Laisi et al. 2009). The authors examined the association of medical records and parental information with the presence of EH in 8- to 13-year-old children (n=147) in Southern Finland. EHs were more frequently registered in children who had taken amoxicillin (OR 2.06, 95%CI 1.01–4.17) or erythromycin (OR 4.14, 95%CI 1.05–16.4) in comparison to those who had not taken these antibiotics during the first year of life. The OR for having EH after exposure to penicillin V was 1.71 (95%CI 0.89–3.27).

Tab. I Crude associations between potential risk factors of caries and the used MIH definitions

	Group (N)	Caries				MIH/1				MIH/2				MIH/3			
		DMF=0 N (%)		DMF>0 N (%)		No N (%)		Yes N (%)		No N (%)		Yes N (%)		No N (%)		Yes N (%)	
Gender	Boys (334)	263	(78.7)	71	(21.3)	206	(61.7)	128	(38.3)	286	(85.6)	48	(14.4)	300	(89.8)	34	(10.2)
	Girls (358)	290	(81.0)	68	(19.0)	224	(62.6)	134	(37.4)	304	(84.9)	54	(15.1)	328	(91.6)	30	(8.4)
Intervention status	Intervention (424)	349	(82.3)	75	(17.7)	272	(64.2)	152	(35.8)	355	(83.7)	69	(16.3)	383	(90.3)	41	(9.7)
	Non-intervention (268)	204	(76.1)	64	(23.9)	158	(59.0)	110	(41.0)	235	(87.7)	33	(12.3)	245	(91.4)	23	(8.6)
Maternal age at birth	18–29 (191)	151	(79.1)	40	(20.9)	122	(63.9)	69	(36.1)	163	(85.3)	28	(14.7)	176	(92.1)	15	(7.9)
	30–32 (218)	178	(81.7)	40	(18.3)	130	(59.6)	88	(40.4)	180	(82.6)	38	(17.4)	196	(89.9)	22	(10.1)
	33–35 (141)	112	(79.4)	29	(20.6)	87	(61.7)	54	(38.3)	122	(86.5)	19	(13.5)	124	(87.9)	17	(12.1)
	36–44 (142)	112	(78.9)	30	(21.1)	91	(64.1)	51	(35.9)	125	(88.0)	17	(12.0)	132	(93.0)	10	(7.0)
Respiratory diseases[1]	≥ 1 (249)	201	(80.7)	48	(19.3)	151	(60.2)	100	(39.8)	213	(84.9)	38	(15.1)	219	(87.3)	32	(12.7)
	None (323)	256	(79.3)	67	(20.7)	206	(63.8)	117	(36.2)	277	(85.8)	46	(14.2)	303	(93.8)	20	(6.2)
	Missing (120)	96	(80.0)	24	(20.0)	73	(61.9)	45	(38.1)	100	(84.7)	18	(15.3)	106	(89.8)	12	(10.2)
Breastfeeding[2]	> 4 months (342)	277	(81.0)	65	(19.0)	207	(60.5)	135	(39.5)	291	(85.1)	51	(14.9)	304	(88.9)	38	(11.1)
	1–4 months (177)	139	(78.5)	38	(21.5)	107	(60.5)	70	(39.5)	155	(87.6)	22	(12.4)	160	(90.4)	17	(9.6)
	Never (136)	105	(77.2)	31	(22.8)	87	(64.0)	49	(36.0)	115	(84.6)	21	(15.4)	129	(94.9)	7	(5.1)
	Missing (37)	32	(86.5)	5	(13.5)	29	(78.4)	8	(21.6)	29	(78.4)	8	(21.6)	35	(94.6)	2	(5.4)
Maternal smoking[3]	Yes (74)	53	(71.6)	21	(28.4)	39	(52.7)	35	(47.3)	62	(83.8)	12	(16.2)	66	(89.2)	8	(10.8)
	No (613)	495	(80.8)	118	(19.2)	387	(63.1)	226	(36.9)	524	(85.5)	89	(14.5)	557	(90.9)	56	(9.1)
	Missing (5)	5	(100.0)	0	(0.0)	4	(80.0)	1	(20.0)	4	(80.0)	1	(20.0)	5	(100.0)	0	(0.0)
Parental education[4]	> 13 years (416)	336	(80.8)	80	(19.2)	256	(61.5)	160	(38.5)	357	(85.8)	59	(14.2)	376	(90.4)	40	(9.6)
	12–13 years (103)	87	(84.5)	16	(15.5)	61	(59.2)	42	(40.8)	88	(85.4)	15	(14.6)	93	(90.3)	10	(9.7)
	10–11 years (133)	103	(77.4)	30	(22.6)	86	(64.7)	47	(35.3)	111	(83.5)	22	(16.5)	124	(93.2)	9	(6.8)
	8–9 years (38)	25	(65.8)	13	(34.2)	27	(71.1)	11	(28.9)	32	(84.2)	6	(15.8)	34	(89.5)	4	(10.5)
	Missing (2)	2	(100.0)	0	(0.0)	0	(0.0)	2	(100.0)	2	(100.0)	0	(0.0)	1	(50.0)	1	(50.0)

[1] Defined as at least one of bronchial asthma, bronchitis, pneumonia or croup during the first 4 years of life.
[2] Defined as exclusively breastfeeding without any formula feeding within the first 4 months of life.
[3] During pregnancy.
[4] Defined as highest educational level of mother or father.

Tab. II Unadjusted odds ratios (uOR), 95% confidence intervals and P-values of the simple logistic regression model for potential risk factors of caries and the used MIH definitions (*P-value <0.05)

	Group	Caries		MIH/1		MIH/2		MIH/3	
		uOR	95%CI	uOR	95%CI	uOR	95%CI	uOR	95%CI
Gender	Boys	1.15	0.79–1.67	1.04	0.76–1.41	0.94	0.62–1.44	1.24	0.74–2.07
	Girls	1.00		1.00		1.00		1.00	
Intervention status	Intervention	0.68*	0.47–1.00	0.80	0.59–1.10	1.38	0.89–2.16	1.14	0.67–1.95
	Non-intervention	1.00		1.00		1.00		1.00	
Maternal age at birth	Inter-quartile range increase[1]	1.00	0.77–1.31	1.00	0.77–1.20	0.90	0.66–1.21	0.91	0.63–1.33
Respiratory diseases[2]	≥1	0.91	0.60–1.38	1.17	0.83–1.64	1.07	0.67–1.71	2.21*	1.23–3.97
	None	1.00		1.00		1.00		1.00	
Breastfeeding[3]	>4 months	0.79	0.49–1.29	1.16	0.77–1.75	0.96	0.55–1.67	2.30*	1.00–5.29
	1–4 months	0.93	0.54–1.59	1.16	0.73–1.84	0.78	0.41–1.48	1.96	0.79–4.87
	Never	1.00		1.00		1.00		1.00	
Maternal smoking[4]	Yes	1.66	0.96–2.86	1.54	0.95–2.50	1.14	0.59–2.20	1.21	0.55–2.64
	No	1.00		1.00		1.00		1.00	
Parental education[5]	>10 years	0.68	0.45–1.02	1.24	0.86–1.78	0.85	0.53–1.36	1.30	0.69–2.45
	≤10 years	1.00		1.00		1.00		1.00	

[1] OR displayed per inter-quartile range increase: a comparison between the 25th and 75th percentile, corresponding to a 6 year difference in maternal age at child's birth.
[2] Defined as at least one of bronchial asthma, bronchitis, pneumonia or croup during the first 4 years of life.
[3] Defined as exclusively breastfeeding without any formula feeding within the first 4 months of life.
[4] During pregnancy.
[5] Defined as highest educational level of mother or father.

Tab. III Adjusted odds ratios (aOR), 95% confidence intervals and P-values of the multiple logistic regression model for potential risk factors of caries and the used MIH definitions. The model was adjusted for gender, intervention status and maternal age at birth (*P-value <0.05)

	Group	Caries		MIH/1		MIH/2		MIH/3	
		aOR	95%CI	aOR	95%CI	aOR	95%CI	aOR	95%CI
Respiratory diseases[1]	≥1	0.96	0.63–1.47	1.24	0.87–1.76	1.04	0.65–1.68	2.48*	1.35–4.56
	None	1.00		1.00		1.00		1.00	
Breastfeeding[2]	>4 months	0.89	0.51–1.53	1.02	0.64–1.62	1.15	0.61–2.17	2.33	0.91–6.01
	1–4 months	0.84	0.47–1.51	1.01	0.61–1.67	0.95	0.47–1.91	1.93	0.70–5.33
	Never	1.00		1.00		1.00		1.00	
Maternal smoking[3]	Yes	1.85*	1.01–3.40	1.50	0.86–2.60	1.27	0.60–2.66	1.86	0.76–4.51
	No	1.00		1.00		1.00		1.00	
Parental education[4]	>10 years	0.65	0.41–1.04	1.39	0.92–2.12	0.82	0.48–1.42	0.95	0.46–1.93
	≤10 years	1.00		1.00		1.00		1.00	

[1] Defined as at least one of bronchial asthma, bronchitis, pneumonia or croup during the first 4 years of life.
[2] Defined as exclusively breastfeeding without any formula feeding within the first 4 months of life.
[3] During pregnancy.
[4] Defined as highest educational level of mother or father.

In the animal experiments of the same study (Laisi et al. 2009) amoxicillin was found to induce earlier enamel formation and/or accelerated enamel accretion rates, which resulted in an irregular hard tissue formation in rats. Based on this observation, it can be speculated that antibiotic therapy, but not the illness itself, could be the key factor for the induction of EH. Unfortunately, only incomplete information about any systemic treatment was collected within the GINI birth cohort study during the first years of life. In light of this limitation, the corresponding systemic therapy should be recorded meticulously within further prospectively designed studies to determine the key factor for the occurrence of EH/MIH. Another indicator for future research is that low prevalence of children with other childhood diseases was not possible to analyze. Therefore, large-scaled epidemiological trials seem to be desirable.

The lack of a significant association between breastfeeding and all MIH categories in the present study (Tab. III) is not in line with previously published findings from Southern Finland (Alaluusua et al. 1996a and 1996b). Several reasons for this inconsistency should be considered. Basically, environmental contaminants such as polychlorinated biphenyls (PCBs) or dioxins are lipophilic substances that can be passed via mother's milk to the newborn. Therefore, breastfeeding can be considered as a potential causative factor. But this is obviously relevant in regions with higher levels of environmental pollution only (Jan & Vrbic 2000, Wang et al. 2003, Alaluusua et al. 2004, Laisi et al. 2008, Jan et al. 2007). Since no major industrial emissions of persistent chlorinated compounds or other environmental pollutants were occurring in the metropolitan area of Munich (Eeftens et al. 2012) in comparison to areas with accidents within the last decades, such analyses were not included in the present evaluations. Due to the general trend of decreasing concentrations of PCBs and dioxins in the environment during the past three decades in Europe, breastfeeding might be excluded with a distinct probability as a potential causative factor for EH/MIH (Laisi et al. 2008).

In the present study, maternal smoking and parental education were included as well-accepted indicators of the socioeconomic status of the children and their families. In accordance with the overall observation that 10-year-old participants of the GINI cohort represent a population with a low caries experience, no positive association was found between caries-associated decay and fillings with parental educational status (Tab. III). Children whose mothers smoked during pregnancy had a significantly higher risk of subsequently developing caries. This aspect emphasizes the importance of low socioeconomic status with respect to caries risk. Interestingly, no associations between socioeconomic status (maternal smoking and parental education) and the presence of MIH (MIH/1, MIH/2, MIH/3) were observed.

Based on the results of the present prospectively designed epidemiological study, we can conclude that only early respiratory diseases within the first 4 years of life were significantly associated with the appearance of MIH/3. However, further investigations are warranted to evaluate if the corresponding systemic treatment of infectious diseases could have a greater influence on the severity of EH compared to the infection itself. Further studies are also necessary to develop a sound explanation for the clinical appearance of EH in children with MIH/1 and MIH/2, as no causative factors could be identified in the present study (Tab. III). It should be further discussed whether the time point of a disease event and/or the corresponding systemic treatment could have an impact on the distribution and severity of EH/MIH in the dentition.

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Résumé

L'étiologie des hypominéralisations doit encore de nos jours être considérée comme inexpliquée. Etant donné que les hypominéralisations sont déterminées dans les premières années lors du développement dentaire, il faut recourir à des études prospectives depuis la naissance évaluant les possibles facteurs contribuant à l'origine de celles-ci. Le but de cette recherche était de voir si les défauts de structure de l'émail, c.-à-d. les hypominéralisations des molaires-incisives (MIH), étaient en relation avec des facteurs prédisposants tels que les maladies des voies respiratoires, l'allaitement, le tabagisme de la mère ou le niveau d'éducation parental comme indicateur socio-économique. La documentation prospective de ces facteurs étiologiques à potentiel de contribution a été faite depuis la naissance jusqu'à l'âge de 4 ans, tandis que le contrôle clinique a eu lieu lorsque l'enfant avait 10 ans. Les données de 692 enfants de 10 ans provenant d'une étude cohorte de naissances (GINI) ont été utilisées. L'évaluation clinique comprenait un statut dentaire des caries ainsi que l'application des critères EAPD pour la saisie des défauts de structure sur toutes les surfaces dentaires. En fonction de la distribution des défauts, les enfants étaient assignés à un phénotype. Le MIH/1 comporte au moins une hypominéralisation de l'émail sur une dent permanente; le MIH/2 au moins une hypominéralisation de l'émail sur la première molaire permanente; le MIH/3 au moins une hypominéralisation de l'émail sur la première molaire permanente et une dent antérieure permanente. Une analyse de régression simple et multiple a été utilisée pour inclure ou exclure toute association entre les trois phénotypes et les facteurs étiologiques avec potentiel de cause à effet. Les résultats montrent que chez 79,9% (n=554) des enfants de 10 ans, la valeur du DMF (decayed, missing & filled) était égale à zéro. En incluant les lésions carieuses sans cavitation, le pourcentage de jeunes enfants sans caries chutait à 40,4% (n=280/DMF/UniViSS=0). Concernant l'hypominéralisation, 37,9% des enfants présentaient au moins une dent hypominéralisée (MIH/1), tandis que 14,7% en avaient au moins 2 (MIH/2) et 9,2% au moins 3 (MIH/3). Les données recueillies ont été ajustées aux possibles facteurs perturbateurs de la minéralisation tels que le sexe, l'âge de la mère à la naissance de l'enfant et les interventions médicales. Seules les affections des voies respiratoires (bronchite, pneumonie, coqueluche,

diphtérie) dans les quatre premières années ont montré une relation statistiquement significative avec les phénotypes MIH/3 (odds ratio = 2.48). L'allaitement des enfants au-delà de 4 mois a également montré un odds ratio augmenté (2.33) mais non significatif. Toutes les autres associations de possibles facteurs avec les phénotypes MIH n'ont rien montré. Le tabagisme de la mère a toutefois été identifié comme un facteur significatif prédisposant à la carie (odds ratio = 1.85) et peut être interprété comme un indicateur du statut socio-économique.

Les données de cette étude ont montré que seules les affections des voies respiratoires au cours des quatre premières années de l'enfant représentent une augmentation significative du risque d'apparition d'une hypominéralisation de type MIH/3. Il reste toutefois à clarifier si la maladie, respectivement sa thérapie ou la prise de médicaments par voie systémique ont une relation de cause à effet pour les hypominéralisations de type MIH/1 ou MIH/2. Il est à relever que la documentation méthodique des hypominéralisations telle qu'appliquée dans cette étude, répertoriant leur distribution par types MIH/1, MIH/2, MIH/3, peut être considérée comme enrichissante pour d'autres évaluations.

Zusammenfassung

Die Ätiologie von Hypomineralisationen muss aus heutiger Sicht nach wie vor als weitgehend ungeklärt angesehen werden. Da Hypomineralisationen während der frühen Zahnentwicklung in den ersten Lebensjahren determiniert werden, können ausschliesslich prospektiv angelegte Studien, welche prädisponierende Faktoren von Geburt an dokumentieren, zu einer validen Ursachenklärung beitragen. Ziel der vorliegenden Untersuchung war es, Strukturstörungen des Zahnschmelzes im Sinne der Molaren-Inzisiven-Hypomineralisation (MIH) in Beziehung zu potenziell verursachenden Faktoren, wie z. B. Atemwegserkrankungen, Stillen, mütterlichem Rauchen oder der elterlichen Bildung als wichtigem sozio-ökonomischem Indikator, zu setzen. Während ätiologisch relevante Faktoren von Geburt an und innerhalb der ersten vier Lebensjahre des Kindes prospektiv dokumentiert wurden, erfolgte die klinische, zahnärztliche Untersuchung im Alter von zehn Jahren.

Insgesamt konnten Untersuchungsdaten von 692 Zehnjährigen aus der GINI-Geburtskohortenstudie ausgewertet werden. Die zahnärztliche Untersuchung beinhaltete neben der Erhebung des Kariesstatus die Erfassung von Strukturstörungen an allen Zahnflächen entsprechend den EAPD-Kriterien. Anhand der dokumentierten Verteilungsmuster wurden die Kinder folgenden Phänotypen zugeteilt: MIH/1: Kinder mit mindestens einer Schmelzhypomineralisation an einem bleibenden Zahn. MIH/2: Kinder mit mindestens einer Schmelzhypomineralisation an einem ersten bleibenden Molaren. MIH/3: Kinder mit mindestens einer Schmelzhypomineralisation an einem ersten bleibenden Molaren und einem bleibenden Frontzahn. Die statistische Auswertung schloss einfache und multiple logistische Regressionsanalysen ein, um Assoziationen zwischen den drei Phänotypen und potenziell ursächlichen Faktoren herzustellen oder auszuschliessen.

Im Ergebnis der Untersuchung wurde bei 79,9% (n=554) aller Zehnjährigen ein DMF-Wert von null aufgefunden. Unter Einbeziehung nicht kavitierter kariöser Läsionen sank die Anzahl kariesfreier Jugendlicher auf 40,4% (n=280/DMF/UniViSS=0). Bei 37,9% der Kinder wurde mindestens ein hypomineralisierter Zahn registriert (MIH/1). 14,7% bzw. 9,2% der Zehnährigen wurden als MIH/2 bzw. MIH/3 klassifiziert. Nach der Adjustierung der Daten für mögliche Störfaktoren (Geschlecht, Alter der Mutter bei Geburt des Kindes und Interventionsstatus) zeigte einzig das Auftreten einer Atemwegserkrankung, wie z. B. Bronchitis, Pneumonie, Kruppanfällen und/oder Keuchhusten, in den ersten vier Lebensjahren einen statistisch signifikanten Zusammenhang mit dem im Alter von zehn Jahren dokumentierten Phänotyp MIH/3 (adjustierte Odds Ratio von 2,48). Bei Kindern, die länger als vier Monate gestillt wurden, lag eine erhöhte adjustierte Odds Ratio von 2,33 vor; dieser Zusammenhang wurde jedoch als nicht signifikant getestet. Alle anderen Assoziationen zwischen den gewählten MIH-Phänotypen und den untersuchten Prädiktoren zeigten keine weiteren statistisch signifikanten Zusammenhänge. Neben diesen Befunden wurde mütterliches Rauchen als ein signifikanter, prädisponierender Faktor für das Auftreten von Karies identifiziert (adjustierte Odds Ratio von 1,85) und kann als Indikator des sozioökonomischen Status interpretiert werden.

Anhand der gefundenen Ergebnisse kann geschlussfolgert werden, dass einzig Atemwegserkrankungen, welche in den ersten vier Lebensjahren auftraten, mit einem signifikant erhöhten Risiko für das Auftreten einer MIH/3 einhergingen. Inwieweit die Erkrankung selbst oder die korrespondierende Therapie bzw. systemische Medikation verursachend wirken, ist ebenso wie die Ursachen für das Auftreten einer MIH/1 oder MIH/2 in weiterführenden Untersuchungen zu klären. Aus methodischer Sicht ist hervorzuheben, dass die zahnbezogene Erfassung von Hypomineralisationen und die Dokumentation typischer Verteilungsmuster (MIH/1, MIH/2 und MIH/3) als Bereicherung für weitere Untersuchungen angesehen werden können.

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