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Dental health in a cohort of six-year-old New Zealand children who were breastfed as infants – a comprehensive descriptive study

Beckett DM, Wheeler BJ, Loch C, Mahoney EK, Drummond BK, Broadbent JM

Abstract

Background and objectives: Enamel defects occur during tooth formation. Identifying variances in presentation and prevalence between and within countries can help researchers identify potential causes requiring further investigation. Children with an early mixed dentition are at an increased risk of dental caries and reliant on others to control their diet and provide oral hygiene assistance. Breastfeeding is recommended by the WHO for the first six months of life and there has been some controversy around breastfeeding in relation to dental caries risk. This study investigated dental enamel defects and dental caries in relation to tooth eruption, diet, and oral hygiene, in a cohort of 6-year-old South Island, New Zealand children who were breastfed as infants.

Methods: 120 children were followed prospectively since birth as part of a breastfeeding study. Participants completed a dental questionnaire and were dentally examined for caries and developmental defects of enamel at age 6 years.

Results: 82 participants were included in this study. The mean age was 6.6 years, 52% were male, and 80% resided in areas of low or medium deprivation. All participants had been breastfed for at least 5 months, with 9% being breastfed beyond 2 years. Two thirds of participants had at least one tooth affected by an enamel defect, with a mean of 6.12 (SD 4.34) affected teeth/affected participants, while half had experienced dental caries. No statistically significant differences were found with breastfeeding duration and dental caries, however there was a trend towards increased dental caries experience and severity with prolonged breast feeding beyond 24 months.

Conclusions: The prevalence of enamel defects and dental caries among participants was high relative to national and international data. Breast feeding for <24 months was not associated with dental caries.

Introduction

Contributing factors for dental caries include the presence of dental anomalies, poor diet, poor oral hygiene, and socio-economic deprivation (Schwendicke et al. 2015). Children with an early mixed dentition are at a high risk of dental caries due to the presence of smaller and less resistant primary teeth, the eruption of immature permanent teeth, and reliance on others to control their diet and provide oral hygiene assistance (Schwendicke et al. 2015). Regarding developmental enamel defects, disturbances during secretion of the enamel matrix can result in hypoplasia, while disturbances or alterations during the maturation (mineralisation) phase can result in hypomineralisation (Elhennawy et al. 2017). Enamel hypomineralisation can range in severity, and the appearance of affected enamel may include demarcated opacities (creamy, white, yellow, or brown), and may result in post-eruptive breakdown (Elhennawy et al. 2017). Teeth with hypoplastic or severe hypomineralisation defects can be hypersensitive, and due to the weaker enamel structure and subsurface porosities, these teeth may be more susceptible to dental caries (Vargas-Ferreira et al. 2015). Hypomineralisation can affect any tooth but is most frequently observed on first permanent molars (FPMs) and permanent incisors, and this condition is referred to as Molar Incisor Hypomineralisation (MIH) (Weerheijm et al. 2003). Approximately 15% of New Zealand children have MIH (Mahoney and Morrison 2009; 2011). Second primary molars form at around the same time as FPMs, and approximately 5-6 % of children present with affected enamel in these teeth, and sometimes also on primary canines (Owen et al. 2017). Internationally, enamel defect prevalence is anywhere between 10-50%, or 30% in the primary dentition (Allazzam et al. 2014; Basha et al. 2014). NZ studies report enamel defect prevalence as between 35 – 63%; however, the indexes used, teeth included, and age of participants vary between studies (Kanagaratnam et al. 2009; Mackay and Thomson 2005; Mahoney and Morrison 2009; Suckling and Pearce 1984).

Breastfeeding is naturally the first nutrition for the majority of infants worldwide and provides ideal early life nutrition for children, with a recommendation from the World Health Organisation for six months of predominant or exclusive breastfeeding (WHO 2003). A recent systematic review examined the relationship between breastfeeding and early childhood caries and concluded that breastfeeding up to 12-months protects against tooth decay (Tham et al. 2015). Data on breastfeeding beyond 12 months has produced mixed findings, with nocturnal breastfeeding after 12 months-of-age (when the primary teeth are erupting) appearing to have the greatest associated risk of dental caries (Tham et al. 2015). Few studies have examined the epidemiology of hypomineralisation in the context of prior breastfeeding. One study has reported that children who were not

breastfed could be considered at risk for developing dental enamel defects, and another suggesting that prolonged breastfeeding may increase the risk of mineralisation defects (Alaluusua et al. 1996; Lunardelli and Peres 2006).

Given the lack of clear data in this area, we conducted a prospective observational study to investigate dental health in a cohort of New Zealand children with a history of exclusive or predominant breastfeeding for at least the first 20 weeks post-partum (as per WHO standards (WHO 2003)). This study aimed to describe the oral health care habits and stage of tooth eruption for participants, as well as the prevalence and severity of both dental caries and dental enamel defects.

Methods

Study population

Children from Dunedin New Zealand who participated in a previous observational study investigating vitamin D status throughout pregnancy and exclusive lactation (n-127) (Wheeler et al. 2017), followed by a subsequent randomized controlled trial (RCT) of a postnatal maternal vitamin D intervention during exclusive breastfeeding (Wheeler et al. 2016), were invited to participate in this study. At the time of recruitment into the dental study, participants were aged five to six years. The methods of the previous studies have been described elsewhere. (Wheeler et al. 2017; Wheeler et al. 2016) Inclusion criteria were pregnant women intending to exclusively breastfeed for at least 20 weeks postpartum and their babies (post birth); and exclusion criteria were premature delivery (prior to 37 weeks gestation), intent to use postnatal vitamin D supplementation, and a history of disorders known to affect calcium and/or vitamin D metabolism. For the current study, inclusion criteria were participation in the previous 2012 trial and being at least 5.5 years of age at time of clinical assessment, and exclusion criteria were inability to cope with a comprehensive dental examination.

Study procedures

All parents gave informed consent for their children to participate, and all children gave assent to be dentally examined. Background demographic information was collected using a questionnaire, and baseline demographic information available through the previous RCT was updated. Deprivation status was measured using NZ Deprivation index 2018 (NZDep2018), a well-recognized measure of socioeconomic deprivation in New Zealand (University of Otago 2018). Standard oral health information was collected to determine caries risk status, exposure to sources of fluoride (toothpaste levels, fluoridated water, mouth rinse, etc.), nutrition (including sugar and dairy consumption), medical history, and homecare habits such as toothbrushing frequency, whether a caregiver helps with brushing, and if a fluoridated toothpaste is used.

A comprehensive clinical dental assessment was conducted (by DB) and calibration for dental caries and enamel defects diagnosis was undertaken (by EM). Tooth surfaces were examined both wet and dry, using an overhead dental light, flat head dental mirror and a periodontal probe to evaluate the integrity of the enamel surfaces. Carious lesions were visually assessed and classified using the International Caries Detection and Assessment System (ICDAS-II) (Ismail et al. 2007). Posterior Bitewing radiographs were taken at the University of Otago Faculty of Dentistry if not available in the previous twelve months from the child's usual dental provider. Lesions were classified using ICDAS-II, and radiographs read by two calibrated paediatric dentists (EM and BD). In cases of disagreement, two further dental academics (DB – dental therapist and JMB – dental public health specialist) reviewed these and came to a consensus on the coding. Enamel defect identification involved visual inspection of wet tooth surfaces. Teeth were examined for the absence or presence of demarcated and diffuse opacities, hypoplasia and/or post eruptive enamel breakdown. Atypical restorations, extractions, and delayed eruption of teeth were recorded. Both the European Academy of Paediatric Dentistry guidelines for diagnosis of MIH (EAPD for MIH), and the Modified Defect of Dental Enamel Index (DDE Index) were used to classify buccal, lingual, and occlusal surfaces of all teeth present (Clarkson and O'mullane 1989; Ghanim et al. 2017).

This study and the previous study approved by the New Zealand Lower South Regional Ethics Committee (H18/001) and (LRS/11/02/007). The original RCT study was also registered prior to commencement with the Australian New Zealand Clinical Trials Registry at www.anzctr.org.auasACTRN12611000108910.

Statistical analyses

Caries severity was coded for analysis using both the decayed, missing and filled teeth (dmft) index, and decayed, missing and filled surfaces (dmfs) index (Bödecker and Bödecker 1931). Primary and permanent teeth mean scores were combined to create a count for the whole mouth. Enamel defects were presented within the categories of demarcated opacities, diffuse opacities, hypoplastic defects, and unknow cause. The mean number of defects were calculated across participants with affected teeth only, and demarcated opacities were dichotomised into mild (white or cream) and moderate to severe (yellow/brown, PEB, atypical restoration or extraction due to defect). Breast feeding data were divided across three duration groups, less than 12 months, 12-23 months, and longer than 24 months.

Statistical analyses were conducted using I/C Stata 16.0. A p-value of <0.05 was deemed statistically significant. Associations between independent variables were tested for statistical significance using the chi-square test for categorical variables while non-parametric analyses (such as the Kruskal-Wallis H test or Mann-Whitney U test) were used for skewed continuous variables such as caries experience.

Results

In total, 119 children were invited to participate in this study; 38 eight had either left the area or declined consent, and 81 were included (Figure 1). Most children identified as NZ European, and the mean age was 6.6 years (SD 0.6). One in five children resided in areas of high deprivation (NZ Dep score 8-10), while 37% resided in areas of low deprivation (NZ Dep score 1-3). Most mothers did not smoke during pregnancy (90%), and no participants were born preterm. All participants were born between November 2011 and September 2013 at the Queen Mary tertiary maternity unit in Dunedin, and all were exclusively or predominantly breastfed for the first 20 week of life (Table 1). Breastfeeding data post 20 weeks were missing for 4 participants (5%), and most were breastfed for 12 months or longer.

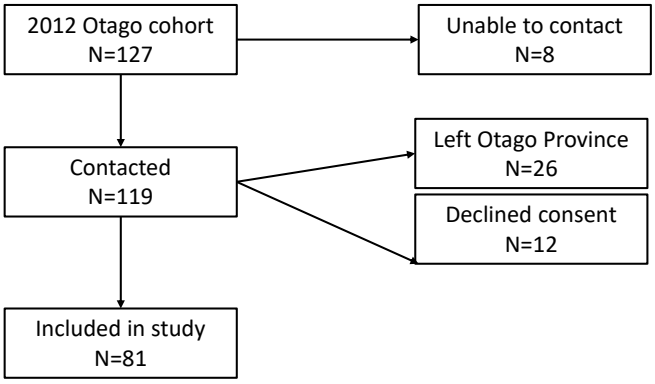

Figure 1. Participation flowchart

Over half of the participants had experienced dental caries by the time of dental assessment, and the prevalence was similar among males and females (Table 2). The mean number of decayed, missing or filled teeth in both the primary and permanent dentitions combined was 1.9 (SD 2.8). Data were right skewed, and dmft scores ranged from 0 to 17. Only one participant presented with caries in a permanent tooth. The mean dmft/DMFT score was higher among those living in areas of high deprivation at 2.6 (SD 4.2), than those living in medium or low areas of deprivation at 1.8 (SD 2.2) and 1.7 (SD 2.6), respectively. When looking at duration of breastfeeding, there were no statistically significant

Table 1. Participants' characteristics

Characteristics	Current Study N=81[1]	Did not participate n=46
Sex		
Male	42 (52.0)	26 (57.0)
Female	39 (48.0)	20 (43.0)
Mean age at dental exam (SD)	6.6 (0.6)	N/A
Ethnicity, n (%)		
NZ European	71 (88.0)	33 (72.0)
NZ Māori	6 (7.0)	2 (4.0)
Other[3]	4 (5.0)	11 (24.0)
Deprivation Index[2], n (%)		
1-3 (Low)	30 (37.0)	14 (31.0)
4-7 (Medium)	35 (43.0)	19 (42.0)
8-10 (High)	16 (20.0)	12 (27.0)
Mean gestation (weeks)	39.7 (1.1)	39.7 (1.1)
Breastfeeding duration[1]		
<12 months	24 (29.0)	*
12-23 months	38 (46.0)	*
24 + months	16 (20.0)	*
Missing BF duration data	4 (5.0)	*
Maternal characteristics		
Maternal smoking during pregnancy, n (%)		
Yes	8 (10.0)	1 (2.0)
No	73 (90.0)	45 (98.0)
Mean age at delivery	33.5 (4.6)	31.7 (5.3)

[1] All children were breastfed until 20 weeks
[2] NZ Deprivation Index 2018
[3] Other ethnicity = Japanese (1), Sinhalese (2), Unknown (1)
* Breastfeeding information post 20 weeks unknown for participants who did not participate

Table 2. Dental caries experience and severity by participant characteristics, caries risk factors and enamel defects

Characteristics	dmft/DMFT[1] Mean (SD)		dmfs/DMFS[2] Mean (SD)		Any caries present N (%)	
Overall	1.9	(2.8)	5.3	(10.6)	45	(56)
Sex						
Male	1.9	(3.0)	5.7	(12.5)	22	(52)
Female	2.0	(2.5)	4.8	(8.1)	23	(59)
Ethnicity						
NZ European	1.8	(2.9)	5.1	(11.0)	36	(51)
NZ Mā ori	2.8	(3.1)	5.7	(8.2)	5	(83)
Other	2.3	(1.0)	7.3	(5.8)	4	(100)
Deprivation						
Low	1.7	(2.6)	4.4	7.6)	14	(47)
Medium	1.8	(2.2)	4.7	(7.9)	20	(57)
High	2.6	(4.2)	8.3	(18.3)	11	(69)
Breastfeeding duration						
<12 months	1.7	(2.1)	3.9	(5.9)	15	(63)
12-23 months	1.6	(2.3)	4.3	(7.9)	18	(47)
=>24 months	2.8	(4.5)	8.8	(18.7)	9	(56)
Missing BF data	2.5	(2.1)	7.0	(5.4)	3	(75)
Traditional caries risk factors						
Brushing frequency						
Not daily	3.3	(4.2)	10.0	(15.6)	2	(67)
1 X per day	2.0	(2.5)	4.0	(6.3)	12	(60)
2 X per day	1.8	(2.9)	5.5	(12.0)	31	(53)
Adult helps brushing						
No	2.1	(2.5)	5.5	(8.1)	26	(62)
Yes	1.8	(3.1)	5.0	(12.8)	19	(49)
Dairy consumption						
Not daily	1.7	(2.3)	1.9	(2.7)	5	(50)
1-2 X per day	2.3	(3.1)	6.3	(13.0)	25	(66)
3+ X per day	1.6	(2.5)	5.0	(9.0)	14	(44)
Missing data	2.0	(0.0)	8.0	(0.0)	1	(100)
Daily sweet drinks						
None	2.9	(3.0)	7.8	(9.3)	12	(63)
1 glass per day	1.6	(2.7)	4.2	(10.9)	30	(52)
2+ glasses per day	2.0	(2.2)	8.5	(11.6)	3	(75)
Daily sweet foods						
None	2.6	(2.4)	4.8	(5.7)	3	(60)
1 serve per day	1.3	(2.2)	3.1	(6.0)	15	(44)
2+ serves per day	2.3	(3.2)	7.1	(13.4)	27	(64)
Enamel defects						
Present						
Yes	2.3	(3.7)	6.5	(14.3)	29	(36)
No	1.7	(2.2)	4.6	(7.6)	52	(64)
Demarcated Opacity						
Mild[3]	1.8	(2.2)	4.7	(7.4)	45	(56)
Moderate to Severe[4]	1.5	(1.7)	4.2	(6.5)	27	(33)

[1] dmft/DMFT: Number of decayed, missing or filled teeth in combined primary and permanent dentition.
[2] dmfs/DMFS: Number decayed, missing or filled tooth surfaces. In combined primary and permanent dentition.
[3] Mild = white or cream demarcated opacity
[4] Moderate/Severe = yellow/brown demarcated opacity, post eruptive breakdown, atypical restoration or extraction due to enamel defect

NB: No statistically significant differences ($p < 0.05$) were observed when looking at participant characteristics, caries risk factors, enamel defect type, and dental caries experience/severity.

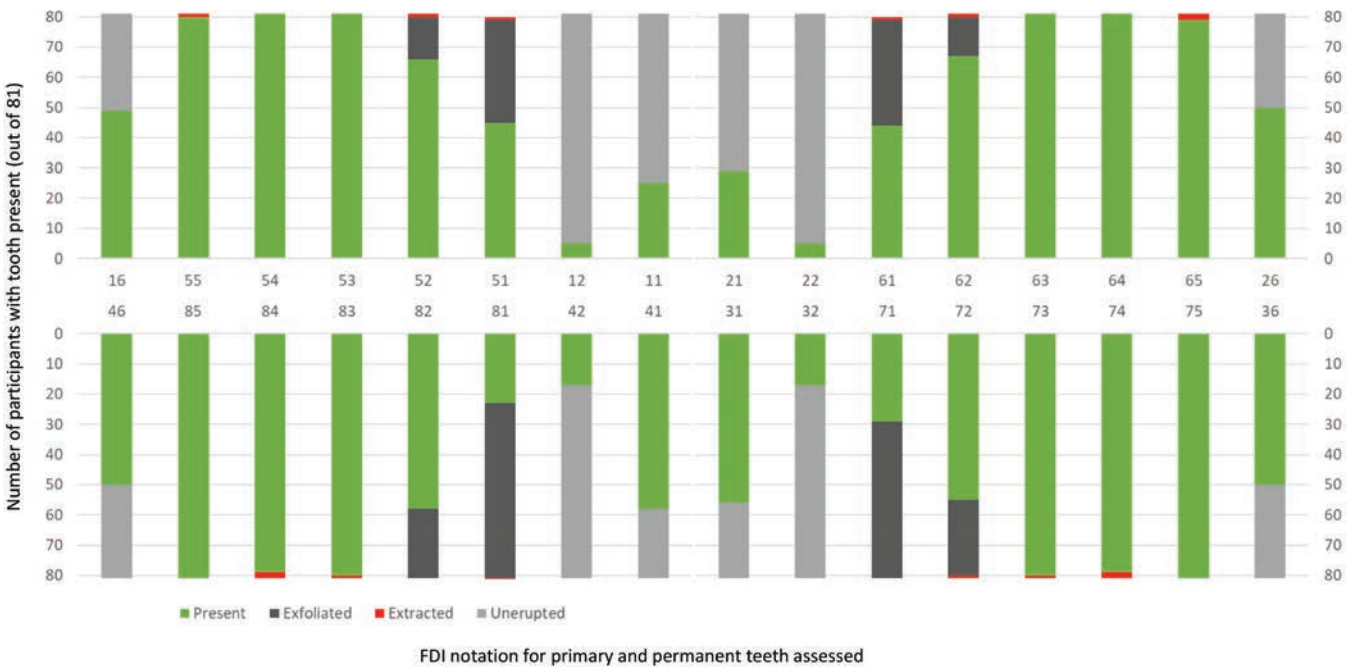

Figure 2. Number of participants and status of each tooth

differences between groups. Those who had breastfed for less than 12 months had a mean dmft/DMFT of 1.7 (SD 2.1), while those who had breastfed for 12-23 months had a similar mean dmft/DMFT of 1.6 (SD2.3). There was a slight increase in caries severity when looking at those who had breastfed for longer than 24 months (dmft/DMFT 2.5: SD 2.1), but this was not statistically significant.

Most children had access to fluoridated water supply at their homes during early childhood, with only three living in a non-fluoridated area. No children were taking supplementary fluoride tablets. Most children were brushing at least once a day (96%), and both caries prevalence and severity at the tooth level followed a gradient in the expected direction, with less caries experience among those who brushed more frequently. Participants who had parents helping them brush their teeth had a lower caries prevalence (49%) than those whose parents did not help (62%), although this difference was not statistically significant (Table 2).

Participants who reported consuming two or more servings of sweet drinks and sweet foods had a higher prevalence of dental caries, and when looking at dmft/dmfs scores, had the greatest number of teeth and surfaces affected. Developmental enamel defects were not associated with caries experience in this group, with participants classified as having moderate to severe demarcated opacities having a lower dmft/DMFT and dmfs/DMFS than those with mild opacities or no enamel defects at all, and this was not statistically significant (Table 2).

Eruption of one or more permanent first molars had been experienced by two in three participants, while lower central incisors had erupted among three in four. Most participants still had their mandibular primary lateral incisors and maxillary central incisors *in situ*, and almost all participants still had their primary maxillary lateral incisors. Fourteen participants were missing one or more teeth following extraction due to dental caries (Figure 2).

Sixty four percent of participants had an enamel defect affecting at least one tooth, with a total of 318 affected teeth, and a mean of 6.12 (SD 4.34) among affected participants (Table 3). The most prevalent enamel defect was demarcated opacities (58%), which was comprised of either a white cream opacity, yellow/brown opacity, or opacity with post eruptive breakdown. Twenty-six participants (32%) had either a yellow/brown opacity or post eruptive breakdown, with a total of 84 defects detected, and a mean of 3.23 (SD 2.67) defects per affected participant. There were 224 demarcated defects identified in total across all participants in both the primary and permanent dentitions, with twice as many in the primary dentition. The mean number of total demarcated defects per affected participant was 4.8 (SD 3.3).

Five participants had atypical restorations, crowns or extracted teeth that were known to be due to an enamel defect but were unable to be classified. All restored or extracted affected teeth were in the primary dentition. Less than a quarter of participants had a diffuse opacity, and of those affected, there were slightly more in the permanent dentition than in the primary dentition. Only six participants were identified as having a hypoplastic defect, and these presented predominately as pitting in permanent incisors. One participant had more than one type of defect on the same tooth, a demarcated opacity and a hypoplastic defect, and these defects were counted twice, once in each category.

Sixty-two participants (77%) had at least one permanent MIH index tooth present (Table 4). Of participants with MIH index teeth present, over two thirds had one or more tooth affected with MIH.

Table 3. Primary and permanent teeth affected by enamel defects

Enamel defect type	Prevalence	Primary Teeth		Permanent Teeth		All teeth	
	N (%)	Total number of defects	Defects per affected participant Mean (SD)	Total number of defects	Defects per affected participant Mean (SD)	Total number of defects	Defects per affected participant Mean (SD)
Demarcated opacities							
White/cream	45 (56)	100	2.22 (1.78)	40	0.89 (1.17)	140	3.11 (1.76)
Yellow/brown	23 (28)	30	1.30 (1.49)	30	1.30 (1.84)	60	2.61 (1.92)
Post eruptive breakdown (PEB)	11 (14)	20	1.82 (2.09)	4	0.36 (0.67)	24	2.18 (1.83)
Either Y/B opacity or PEB	26 (32)	50	1.92 (2.61)	34	1.31 (2.02)	84	3.23 (2.67)
Total Demarcated	47 (58)	150	3.19 (3.18)	74	1.57 (2.22)	224	4.77 (3.27)
Diffuse opacities	16 (20)	21	1.31 (1.54)	31	1.94 (2.72)	52	3.25 (2.44)
Hypoplastic defects	6 (7)	8	1.33 (1.21)	4	0.67 (0.86)	12	2.00 (0.63)
Unknown							
Atypical restoration, SSC, or extracted due to enamel defect	5 (6)	31	6.20 (3.70)	0	0.00 (0.00)	31	6.20 (3.70)
Any defect	52 (64)	210	4.04 (3.91)	108	2.08 (2.71)	318	6.12 (4.34)

* Only 1 participant had a combination of defects on the same tooth (demarcated and hypoplastic) and these have been counted twice – once for each defect type.
** The mean number of defects is for those with affected teeth only

Table 4. Prevalence of Molar-Incisor Hypomineralisation (MIH) and/or Hypomineralised Primary Second Molar (PSM) with summary of affected teeth

	One or more index teeth present[1] N (%)	One or more hypomineralised teeth[1] N (%)	Females: count of MIH-affected teeth[1] (% of index teeth)	Males: count of MIH-affected teeth[1] (% of index teeth)
Total MI[2]	62 (77)	25 (40)	14 (56)	11 (44)
Total PSM[3]	80 (99)	31 (39)	15 (48)	16 (52)
Total MIH or PSM[4]	80 (99)	46 (58)	23 (50)	23 (50)
By specific teeth				
Molar	Tooth present N (%)			
16	49 (60)	9 (18)	6 (67)	3 (33)
26	49 (62)	13 (26)	10 (77)	3 (23)
36	51 (63)	8 (16)	5 (63)	3 (38)
46	50 (62)	4 (8)	3 (75)	1 (25)
Incisor				
11	25 (31)	4 (16)	3 (75)	1 (25)
12	5 (6)	0 (0)	0 (0)	0 (0)
21	29 (36)	5 (17)	1 (20)	4 (80)
22	5 (6)	0 (0)	0 (0)	0 (0)
31	55 (68)	4 (7)	3 (75)	1 (25)
32	17 (21)	0 (0)	0 (0)	0 (0)
41	58 (72)	3 (5)	2 (67)	1 (33)
42	17 (21)	0 (0)	0 (0)	0 (0)
Second primary molar				
55	73 (91)	15 (21)	8 (44)	10 (56)
65	74 (91)	18 (24)	8 (44)	10 (56)
75	73 (91)	14 (19)	8 (50)	8 (50)
85	74 (91)	14 (19)	9 (53)	8 (47)

1 Index Teeth able to be scored (not extracted, unerupted, or crowned for reason other than enamel defect)
2 Children with no permanent 1st molars or incisors excluded from this row
3 One child with no primary 2nd molars excluded this row
4 One child missing either permanent 1st molars, incisors, or primary 2nd molars excluded this row

Most participants had their primary second molars present, with 39% having at least one primary molar affected by HPSM. In total, over half of all participants showed evidence of either MIH or HMPS as categorized by the EAPD for MIH classification. Maxillary teeth were more likely to be affected than mandibular teeth, and this was clinically evident across all primary and permanent index teeth. There were no significant differences between males and females for the prevalence of either MIH or HPSM.

Discussion

This study presents detailed descriptive dental data on a predominately NZ European cohort that was breastfed for at least 5 months. The main finding is a high rate of enamel defects in at least one tooth (64%), which were of mixed type. In addition, more than half of participants had experienced dental caries, with a mean dmft of almost 2 in the combined dentition. A clear gradient was evident when looking at tooth brushing habits and dental caries, with those brushing twice a day having a lower caries experience. Dental caries severity was no different between children who had breastfed for less than 12 months and between 12-23 months, but increased slightly for children who were breastfed beyond 24 months, however this difference was not statistically significant. More severe dental caries was observed for participants who reported consuming two or more servings of sweet drinks or foods per day.

Our study used both EAPD for MIH and DDE indexes, therefore was comparable with studies from other regions of New Zealand (Kanagaratnam et al. 2009; Mackay and Thomson 2005; Mahoney and Morrison 2009), although the number of index teeth included in the analysis and age of participants differed. The distribution of enamel defects in these NZ studies were similar to our findings, with demarcated defects being the most observed, followed by diffuse opacities and hypoplastic defects. A fourth study used the FDI index, which differed slightly to DDE and EAPD for MIH in the classification of defects, however included all teeth in their analysis. Overall prevalence of defects was similar to our data at 63% and 64% respectively (Suckling and Pearce 1984). Prevalence of enamel defects in the NZ North Island (20%–35%) appears less than the South Island (52%–63%), and this warrants further investigation around access to care and other potentially contributing factors. The findings from our Dunedin study are consistent with the South Island figures from other locations (Kanagaratnam et al. 2009; Mackay and Thomson 2005; Mahoney and Morrison 2009; Suckling and Pearce 1984).

Methodological differences may result in under or over-estimate of findings. Participants in our study were younger than the aforementioned NZ studies by 2-3 years, therefore did not all have their permanent incisors or molars present. When looking only at participants with at least one permanent incisor or molar present, the prevalence of MIH in our study was 40%, or 58% if including HFPM's. Due to some children not having all teeth erupted, this is likely to be underestimated. This is significantly higher than MIH prevalence reported in Wainuiomata (North Island), with 15% of children with MIH (Mahoney and Morrison 2009). Two Southland studies reported enamel defects for between 51.6 and 63% of participants, with the later figure being from the study that included all teeth in their analysis, which is consistent with our findings (at 64% of participants) (Mackay and Thomson 2005; Suckling and Pearce 1984).

The number of children recorded as having experienced dental caries at the 2018 MOH 5-year-old caries data for NZ was 40%, with a mean dmft of 1.8 (MOH 2018). When comparing with other countries with a publically-funded child dental service, these figures are slightly higher than for Australian children aged 6-7, which reported 34% of children had experienced dental caries, with an average dmft of 1.3 (AIHW 2020), and almost double than 5-year-olds from England, with 23% having experienced dental caries, with a mean dmft of 0.8. The NZ Southern District Health Board (DHB) (which encompasses Dunedin), reported that 33.7% of children in the area had experienced dental caries, with a mean dmft of 1.2 (MOH 2018). In this study, 56% of participants had experienced dental caries with a mean dmft of 1.9, which was higher than both the regional and national figures for both prevalence and severity. Ethnic and social disparities in dental caries experience are well understood, with those living in areas of high deprivation, or from ethnic minority groups, known to carry a greater burden of disease(Beckett and Meldrum 2018). Given this cohort was predominately NZ European, and 80% were living in areas of medium or low deprivation, these findings were unexpected. NZ Ministry of Health (MOH) data is collected by dental and oral health therapists employed by the Community Oral Health Service, and radiographs are not routinely taken before age 5. Radiographs are able to detect early lesions that are often not clinically visible, therefore the higher caries prevalence in our study could be a reflection of the comprehensive assessments that included posterior bitewing radiographs, and therefore may represent a more accurate reflection of the true caries experience for this age group in Dunedin than that previously documented.

Exclusive breastfeeding for the first six months of life is recommended by the WHO, and the findings from this study support this recommendation (WHO 2003). Some concern has previously been raised about longer breastfeeding durations, in particular the potential risk seen with nocturnal feeding (Tham et al. 2015). However, following our detailed data collection and assessments we identified no statistically significant differences with breastfeeding duration and dental caries. Importantly, breastfeeding up to 24 months was not found to be a caries risk factor in this cohort. There was a slight trend towards increased dental caries severity with breast feeding beyond 24 months, which potentially supports previous research that has found that prolonged breastfeeding beyond 24 months may increase the risk of dental caries (Tham et al. 2015).

As expected, participants in our study experienced less dental caries if they brushed at least once a day,

and had an adult who helped. Those who consumed more servings of sugar per day through either drink or food also experienced more dental caries. These findings are consistent with what is known about the role of diet and oral hygiene in dental caries (Andlaw 1978; Hujoel et al. 2018). The lack of statistical significance for this cohort is most likely due to the lower number of participants, and findings can still be viewed as clinically important and consistent.

Strengths of this study are the robust data collection around breastfeeding and its duration, and the thorough clinical assessments that included posterior bitewing radiographs, and detailed caries information that was recorded using ICDAS (Ismail et al. 2007). Defects were categorised using both the DDE (on all teeth present) and EAPD for MIH, to ensure all defect types on all teeth were recorded, and MIH prevalence for index teeth could be extrapolated and compared to other studies (Clarkson and O'mullane 1989; Weerheijm et al. 2003). While this study had low numbers of NZ Māori participants (7%), this was consistent with the demographic characteristics of Dunedin city overall (7.7%) (Statistics NZ 2013). Dunedin also typically has low numbers of those living in areas of high deprivation, with only 7.9% of areas identified as highly deprived (Chiang and Exeter). 20% of participants in our study were categorised as living in areas of high deprivation, therefore all deprivation groups were well represented. Similar to most studies, there are limitations in this investigation, and due to it being a descriptive study, we were unable to determine causation of either dental caries or enamel defects. While the children in this study had a mean age of 6.6 years, it became apparent that they were still too young to have erupted all their permanent incisors and molars. Given that only participants with at least one MIH index tooth were included in the MIH analysis (77%), the figures from our study are likely to be an underestimate of the true figure; however still of clinical importance.

In summary, enamel defect prevalence was high in this cohort, which corroborates previous studies suggesting that enamel defects are more prevalent in the South Island than the North Island of New Zealand. Dental caries experience was high when compared with national and international 5-year-old data, and good oral hygiene practices and reduced sugar consumption positively impacted on dental caries experience and severity. No statistically significant different was found between breastfeeding duration and caries risk.

Why this paper is important

1. Enamel defects appear more prevalent in the South Island than the North Island of New Zealand, and reasons for this need to be further investigated.
2. Dental caries prevalence and severity were high when compared to Dunedin MOH caries data, and this is likely due to the comprehensive assessment provided that includes intra-oral radiographs, therefore a more accurate representation of caries prevalence in Dunedin NZ.
3. Breastfeeding duration does not appear to be a prominent risk for caries. However, good oral hygiene practices, parents assisting with toothbrushing, and reduced sugar consumption positively impacted on dental caries experience and severity, and this is in line with current literature.

Ethical Approval

University of Otago Human Ethics Committee (Health) 31 January 2018. Reference number H18/001.

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Author details

Deanna Beckett, Lecturer Dip D.Therapy, DPH, MPH
Oral Sciences, Sir John Walsh Research Institute, University of Otago
Corresponding author: Deanna.beckett@otago.ac.nz

Benjamin John Wheeler, Associate Professor/Paediatric Endocrinologist MBCHB, DCH, CCE, FRACP, PhD
Women's & Children's Health, Dunedin School of Medicine, University of Otago

Jonathan Broadbent, Professor BDS PhD PGDipComDent
Oral Sciences, Sir John Walsh Research Institute, University of Otago

Carolina Loch, Senior Lecturer BSc MSc PhD
Oral Sciences, Sir John Walsh Research Institute, University of Otago

Dr Erin Mahoney, Clinical Lecturer BDS, MDSC, PhD, FRACDS, MRACDS
Paediatrics, University of Otago, Wellington

Bernadette Drummond, Professor BDS, MS, PhD, FRACDS, FDSRCSEd
Professor Emeritus, School of Dentistry, University of Leeds