White Rose Research Online

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk
Universities of Leeds, Sheffield and York

Deposited via The University of Leeds.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/id/eprint/90299/

Version: Accepted Version

Article:
Feldens, CA, Day, PF, Borges, TS et al. (2016) Enamel fracture in the primary dentition has no impact on children's quality of life: implications for clinicians and researchers. Dental Traumatology, 32 (2). pp. 103-109. ISSN: 1600-4469

https://doi.org/10.1111/edt.12222

Reuse
Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

UNIVERSITY OF LEEDS
University of Sheffield
UNIVERSITY of York

Enamel fracture in the primary dentition has no impact on children's quality of life: implications for clinicians and researchers

ABSTRACT

Aim: To quantify the impact of traumatic dental injuries (TDI) on Oral Health Related Quality of Life (OHRQoL) of preschool children, when enamel fractures were either included or excluded within the category of TDI. **Material and Methods**: An oral health survey was undertaken of preschool children, age 1-5 years attending public nurseries in Canoas, Brazil. Children were examined for TDI, dental caries and malocclusion. Parents were interviewed on their perception of their child's OHRQoL (Early Childhood Oral Health Impact Scale – ECOHIS) and their sociodemographic background. Multivariable Poisson regression models with robust variance were fitted to assess the impacts of TDI (including and excluding enamel fractures) on OHRQoL. **Results**: A full dataset was collected from 76% of the eligible population. The prevalence of TDI was 13.4% (171/1275). The prevalence of any impact (ECOHIS≥1) was significantly higher in children with crown discoloration (29.7%), enamel/dentin fracture (29.2%) and avulsion (73.3%), compared to children with enamel fracture (16.2%) or without a TDI (15.8%) ($p<0.001$). Enamel fractures were the most prevalent TDI (40%) but halved the proportion of children with a reported impact from their TDI. The mean increase in OHRQoL impact for those children with a TDI was 1.59 (95%CI 1.20-2.10) when enamel fracture was included, and 1.86 (95%CI 1.39-2.50) when it was excluded. **Conclusion**: Enamel fractures have no significant impact on young children's quality of life. Including enamel fractures within the diagnosis of TDI increases the prevalence of TDI while reducing the OHRQoL impact of TDI for the primary dentition.

KEY WORDS: tooth injuries, child, preschool, primary tooth, quality of life

INTRODUCTION

The identification of clinically relevant outcomes is critical when identifying priorities in public health (1). Although traumatic dental injuries (TDI) in the primary dentition can cause occlusal, aesthetic or psychological problems and disturbances to the development of the permanent dentition, many studies to date have found no association between TDIs and parental reported oral health related quality of life (OHRQoL) in preschool children (2-4). Table 1 shows the results from previous studies that investigated the effect of TDI in primary teeth on OHRQoL.

Data from epidemiological studies describes enamel fractures as the most common dental injury in the primary dentition (5-8). However, the consequences of enamel fracture appear to be minimal with few children or their parents complaining about their aesthetics of these injured teeth or recounting any symptoms (9,10). Thus, the inclusion of children with enamel fractures within the category of TDI significantly increased the reported prevalence of TDI to the primary dentition, while attenuating the impact of TDI on the child's quality of life. This may lead to the conclusion that all TDI have minimal impact on the quality of life of preschool children and their families.

Quantifying the impact of enamel fracture in primary teeth on quality of life is extremely important clinically as it may support current treatment guidelines (11). To date, the IADT (12) guidelines advise that the sharp edges are smoothed with a bur and clinical and radiographic examination is undertaken at 3-4 weeks (13).

Thus, the aim of this study was to quantify the impact of TDI, when enamel fractures were either included or excluded within the category of TDI, on Oral Health Related Quality of Life (OHRQoL) of preschool children living in Southern Brazil.

METHODS

Participants and study design

A cross-sectional study of preschool children was undertaken. Children were aged 1-5 years old and were enrolled in the public nurseries of Canoas, a town located in the southern region of Brazil. The city has a population of approximately 324,000 inhabitants and all households have access to public water supply with fluoride level of 0.8 ppm.

The oral health census was undertaken between June 2010 and January 2011. This study received approval from the Human Research Committee of Universidade Luterana do Brasil (ULBRA; number 2009-130H). The children`s parents read and signed an informed consent form prior their participation. Children with dental pathology were referred for treatment. All children aged 1-5 years, who were enrolled in the 31 public preschools in Canoas as well as their parents were invited to participate (n=1683). Children were excluded from the study if they were pre-dentulous or if one or more permanent teeth had erupted.

Data collection

The fieldwork team consisted of six pairs of examiners (qualified dentists) and an auxiliary (undergraduate dental students). Within a nursery setting, data were collected from June 2010 to January 2011 by means of children's clinical oral examination and a face-to-face structured interview with their parent or guardian. Parents were invited to answer questions relating to their socioeconomic background and a questionnaire regarding their child's OHRQoL.

Socioeconomic questionnaire – control variables

The socioeconomic questionnaire provided information about child's gender (male and female) and age (1,2,3,4 and 5-years old); mother´s age (gathered in years and later categorized <20 years; 20-35 years; >35 years); family structure (i.e. nuclear, child living with mother and father vs. nonnuclear, other condition of living); mother´s education (recorded in years of schooling and later categorized as <9 years; 9-11years; >11 years), number of people living at the child's home; monthly family income (total earning of all members of family, measured in Brazilian currency (R$) and later categorized in tertiles; US$ 1 was equivalent to R$ 1.7 at the time of data collection) and use of dental services.

Parent reported Oral Health Related Quality of Life (OHRQoL) questionnaire

The Early Childhood Health Impact Scale (ECOHIS), initially proposed by Pahel et al. (14) and later validated in Brazilian Portuguese by Tesch et al. (15), is a specific instrument developed to assess the perception of parents on OHRQoL of preschool children. It is structurally composed of 13 items distributed between two sections: the Child Impact Section (CIS) and the Family Impact Section (FIS). The CIS has four domains (child symptom, function, psychological and self image/social interaction); and FIS has two domains (parent distress and family function).

Answers were recorded using a *Likert* scale to record how often an event has occurred during the life of the child: 0=never; 1=hardly ever; 2=occasionally; 3=often; 4=very often; 5=don't know. The total ECOHIS scores for individual domains were calculated as a simple sum of the response codes, after recoding all "don't know" responses as missing. For those with up to two missing responses in the CIS or one in the FIS, a score for the missing items was imputed as an average of the remaining items for that section. Children with three or more missing answers on the CIS or two or

more missing answers on the FIS are excluded from analysis. The CIS and FIS ECOHIS range from 0 to 36 and from 0 to 16, respectively, for which higher scores indicate a greater impact from their oral health problems and were thus more likely to have poorer OHRQoL (16)

Clinical examination – exposure (TDI) and control variables (dental caries and malocclusion)

The children were examined in a classroom at the preschool lying on ordinary desks under natural light. First the teeth were cleaned and dried with gauze. The clinical examination was exclusively visual, with the help of a dental mirror, tongue depressor and a millimeter ruler, as detailed elsewhere (17). Biosafety measures established by the World Health Organization (WHO) were strictly followed (18).

The exposure of the present study, TDI, was assessed following Andreasen classification (19) and later categorized into no injury, enamel fracture, enamel/dentin fracture, crown discoloration and avulsion.

The WHO criteria for the diagnosis of decayed, missing and filled teeth (dmft) were applied (18). The dmft was categorized into caries free, low severity and high severity. High severity was based on the Significant Caries Index (SiC), which represents the mean dmft of the third of the population study with the highest caries score (20).

Malocclusion was evaluated using standard, previously published definitions (21,22): *incisor overjet*, measured as the distance between the palatal surfaces of the most protruded maxillary incisor and the labial surface of the corresponding mandibular incisor and later categorized into normal (≤ 2 mm) and increased (> 2mm); *anterior open bite*, defined as the absence of a vertical overlap of the lower incisors; and

posterior crossbite when upper primary molars occlude in lingual relationship to the lower primary molars. Occlusion was assessed with teeth in centric occlusion and children were categorized according to the presence of at least one of these conditions.

Quality assurance

Dental examiners underwent a rigourous training program. This included a discussion of all possible classifications and criteria used in the study for the diagnosis of each oral health condition through an analysis of photographs and dental cast models. An instruction manual for the fieldwork team was prepared and used during the training and throughout the data collection. Clinical training was supplemented further with an exercise involving 20 children of the same age and not part of the sample. This was performed to test the methodology and the comprehension of the indices.

Intra and inter-examiner reliability were assessed using weighted (dental caries) and simple (malocclusion and TDI) Kappa statistics for the two dental examinations 10 days apart in 40 children aged 2-5 years. Dental caries, malocclusion and TDI in all 40 children were independently examined by the six examiners. Inter-examiner reliability for dental caries ranged from 0.83 (95% CI 0.71-0.95) to 1.00 and intra-examiner reliability ranged from 0.93 (95% CI 0.86-1.00) to 1.00. The assessment of intra and inter-examiner reliability showed a perfect agreement (100%) for TDI (kappa=1.00); and at least a substantial agreement for malocclusion: inter-examiner reliability ranged from 0.84 (95% CI 0.64-1.00) to 1.00 and intra-examiner reliability ranged from 0.79 (95% CI 0.60-0.98) to 1.00.

Outcome - OHRQoL

The primary outcome in this study was the occurrence of any impact on OHRQoL (ECOHIS ≥ 1), i.e., prevalence of one or more items reported as hardly ever,

occasionally, often or very often. The overall and domain-specific ECOHIS scores were the secondary outcomes of this study.

Data analysis

The database was constructed using double entry of data. Statistical analysis was undertaken using the Statistical Package for Social Sciences (version 16.0; SPSS Inc., Chicago, IL, USA). Given that some children presented with more than one type of trauma and the unit of analysis was the child, the most severe traumatic injury was recorded, according to the following sequence determined *a priori*: enamel fracture <enamel and dentin fracture <avulsion. To determine the hierarchy of crown discoloration - a common finding in this study - its impact on OHRQoL with other types of trauma was compared. This previous analysis showed that the impact of crown discoloration was higher than enamel fracture and lower than enamel and dentin fracture. The small number of children with intrusive luxation (n = 2) and lateral dislocations (n = 2) prevented these children from being included in the analysis. Thus, to determine the most significant trauma to each child, the following hierarchy was used: enamel fracture < crown discoloration < enamel and dentin fracture < avulsion.

Descriptive and unadjusted analysis provided summary statistics assessing the association of the overall and domain-specific ECOHIS scores and the exposure variables. Due to the positively skewed distribution of ECOHIS scores, a nonparametric test (Kruskal–Wallis) was used to compare the scores between the categories of TDI; the level of significance was set to 5% ($p < 0.05$). Pairwise comparisons regarding levels of TDI were carried out with Bonferroni correction; the level of significance was set to 1.7% ($p < 0.017$) (23). Chi-square tests as well as unadjusted and adjusted multivariable Poisson regression models with robust variance were fitted to assess

exposures for the prevalence of impacts on OHRQoL. Previously detected confounding variables (age, dental caries and malocclusion) (24) were included in the multivariable models in order to examine the independent effects of levels of TDI on OHRQoL. Attendance at a dental professional and number of teeth were also included in the initial models, since these variables are potential confounders. This strategy allowed estimating prevalence ratios among comparison groups and their respective 95% confidence intervals. Two multivariable models were fitted to assess the impact of enamel fracture on OHRQoL: (1) all TDI including enamel fracture and (2) TDI excluding enamel fracture. An additional model was fitted to compare the effect of TDI categorized into: without trauma /enamel fracture/other TDI. Control variables with $p<0.20$ were maintained in the final regression model.

RESULTS

Among the 1683 children aged one to five years enrolled at public preschools in the city of Canoas, Brazil, dental exams were undertaken on 1488 (response rate= 88.4%). The reasons for the losses were repeated absence from preschool (n=93), failure to sign the parental/caregiver consent form (n=39), children who were uncooperative for the physical examination (n=33) and inability to contact the parent/caregiver to undertake the interview (n=30). Among the 1488 children examined, 213 were excluded from the sample due to the presence of permanent teeth or exfoliation of anterior tooth (n=197), history of orthodontic treatment (n=12) or the low frequency of the injury that did not allow statistical analysis (lateral luxation: n=2; intrusion: n=2).

The final sample comprised of 1,275 children: 663 (52.0%) boys and 612 girls (48.0%). The children were divided into the following age groups: 1 year old (13.0%); 2

years old (18.4%); 3 years old (24.9%); 4 years old (26.9%); and 5 years old (16.8%) (Table 2). The prevalence of TDI was 13.4% (171/1275): 68 enamel fracture, 64 crown discoloration, 24 enamel/dentine fracture and 15 avulsion. The proportion of children with TDI who had consulted a dentist was low: only 25.5% of parents took their child to a dental professional following an enamel fracture compared to 46.6% for more severe TDI.

The ECOHIS scores ranged from 0 to 36 with a 0.82 mean (SD = 2.87); 17.4% of the caregivers (222/1275) reported that their children had an impact on at least one ECOHIS item. Among those reporting any impact, mean (SD) ECOHIS score was 4.7 (5.4) and median (interquartile range) was 3.0 (1.0-6.0). Negative impact on OHRQoL was more prevalent on CIS (197/1275; 15.5%) than FIS (95/1275; 7.5%).

Table 3 shows that ECOHIS scores varied significantly according to type of TDI ($p < 0.001$). Furthermore, the prevalence of any impact (ECOHIS≥1) was significantly higher in children with crown discoloration, enamel/dentin fracture and avulsion, compared to children with enamel fracture and those without a TDI.

There was a significant difference in scores between the levels of TDI regarding total ECOHIS and four of the six domains (Symptom Domain, Function Domain, Parent Distress Domain and Family Function Domain (Table 4). When the categories were compared to each other, there were no significant differences in scores of total ECOHIS and scores of domains between children without trauma and children with enamel fracture; however, a significant difference was detected between children without trauma and children with other types of TDI regarding scores of total ECOHIS and four of the six domains (Symptom Domain, Function Domain, Parent Distress Domain and Family Function Domain).

Table 5 shows prevalence ratios of any impact on OHRQoL according to different outcomes. The unadjusted models showed that the probability of any impact was significantly higher in children with TDI, independent of the type of outcome. The multivariable models (after adjustment for age, malocclusion, use of dental services and dental caries) showed that the probability of any impact was 59% higher in children with any type of TDI compared to children without TDI (PR 1.59; 95% CI 1.20-2.10). However, when enamel fracture was not included in the outcome, the probability of any impact increased almost 90% (PR 1.86; 95% CI 1.39-2.50). When three categories were considered, there was no difference between children with enamel fracture and without TDI.

DISCUSSION

The main finding from this study was that the inclusion of enamel fractures in the diagnosis of TDI in primary teeth significantly reduces the impact on OHRQoL. When enamel fractures were categorised within the no TDI category, there was a significant increase in OHRQoL scores for TDI. Furthermore the proportion of children reporting an impact from their TDI as measured by the OHRQoL questionnaire increased from 28% of those with a TDI to 36% when enamel fractures were excluded. To the best of our knowledge, this is the first investigation to compare the effect of including and excluding enamel fracture within the diagnosis of TDI on the OHRQoL of preschool children.

A few studies have addressed the impact of TDI on OHRQoL in preschool children and the evidence is conflicting (2-4, 24-29). Such divergences may be explained by methodological differences, such as the considerable variation in sample size (ranging from less than 300 to more than 1600 children) and the setting of the study

[community (population-based study) or a university dental service]. The present findings suggest that the inclusion of enamel fractures in the diagnosis of TDI may contribute to the failure to detect a significant impact on OHRQoL in some studies or at least reduce its true impact in others (2-4, 24).

Ideally, studies from different parts of the world should quantify the effect of each type of TDI diagnosis on the quality of life. However, such a task is burdensome, as it would require a very large sample size, in order to capture sufficient numbers for all types of TDI where some diagnoses have a low prevalence. For example, in this sample of 1275 children only four children had clinically diagnosable luxation injuries which could be further subdivided into two lateral luxations and intrusions. Thus, in the absence of such a study, it would seem sensible to broadly categorise TDIs. However such an approach makes it difficult to establish a definitive cut-off point at which TDI cause a significant impact in quality of life of young children. Analysing the effect of severe TDI, Aldrigi et al. (25) and Abanto et al. (30) detected impact on quality of life only for complicated TDI, whereas Viegas et al. (26) reported impact only stemming from avulsion and discolouration.

Enamel fractures should be identified and monitored owing to the possibility, although rare, of medium and long-term consequences (10). The direct contamination of the pulp by micro-organisms explains the occurrence of pulp necrosis following hard tissue trauma (19), but this event is not plausible after fracture enamel without a concomitant periodontal injury. From the standpoint of children and their families, it seems unlikely that such fractures have an impact on daily functioning, well-being or overall quality of life, as confirmed by the present findings. Indeed almost three quarters of parents did not take their child to a dental professional following an enamel fracture compared to 53.4% for more severe TDI. These findings agree with other authors who

concluded that a large portion of parents do not recognize the occurrence of minor TDI in their children. (31) Additionally, the diagnosis of enamel fracture can be confused or misclassified with other dental pathology such as tooth wear, being difficult to calibrate examiners (32).

The identification of clinically relevant outcomes is critical when identifying priorities in public health and studies that assess the impact of adverse oral conditions on OHRQoL are essential (1). By including enamel fractures in the diagnosis of TDI, the most prevalent injury but with a minimal impact on OHRQoL, this may mask or attenuate the genuine effect of more severe injuries, thus leading some studies to conclude that TDI to the primary dentition have a minimal impact on young children's OHRQoL. This may hinder the appropriate prioritization being given to TDI, thereby hindering the planning of policies aimed at the prevention of TDI as well as the organization of dental services that include the treatment of TDI and its consequences. In comparing the OHRQoL scores for different oral pathologies, collected in the same study but reported in different papers, TDI (mean OHRQoL 1.86) would come below severe caries (3.67) and above both low severity caries and malocclusion (mean OHRQoL 1.28 and 0.95 respectively) (24). Thus, future studies addressing the effect of TDI on the quality of life of preschool children either should exclude enamel fractures or evaluate this type of TDI separately.

Some methodological aspects of the present study merit discussion. Firstly, data on OHRQoL were skewed towards the "no impact" end of the scale ("floor effect"), with more than 80% of the subjects reporting "never" having experienced problems. Given the skewed distribution of scores for quality of life, we opted to report not only the mean scores, but also the frequency of children with any impact. This distribution of scores was characteristic of population-based studies and was likely indicative of

genuinely low levels of problems. It was also possible that the OHRQoL assessment tool employed was not sufficiently sensitive to the problems that were actually experienced. However, the discriminative ability of the ECOHIS questionnaire has been demonstrated, showing that parents can provide valid reports for their preschool children (14,15). Secondly, the cross-sectional design was a limitation of the present study, as it did not allow the role of time between exposure and outcome to be examined. Therefore, the term impact in this study does not relate to causality, but to the outcome of the validated instrument: namely impacts on the child and family domains (14). Furthermore, studies with cross-sectional design may not capture the fluctuant effect of TDI, as parents may not remember their impact when the child was younger (25). However, ECOHIS has been designed to consider precisely the child's entire life experiences (14). Moreover, memory bias is not expected to be large in preschool children because of the short period of early childhood. Thirdly, the data involved 1275 preschool children aged one to five years in a representative sample of children enrolled in public preschools and nurseries in the city of Canoas. However, caution should be exercised when generalizing the results to all preschool children in the city as public school nurseries are predominantly used by children from lower socioeconomic backgrounds.

This and other cross sectional research studies show a clear need for future prospective longitudinal studies to be undertaken. While cohort studies would be expensive to establish, owing to the large number of children required to ensure rarer types of TDIs to the primary dentition are sufficiently represented to enable meaningful statistical analysis, this study design would facilitate the impact of TDIs to be analyzed over the short, medium and long term. While this design unlike a randomised controlled trial does not mandate the treatment provided for different injuries, the study could

provide insight into different treatment approaches and include outcomes relating to the tooth, child, their family and the wider health care organisation. Furthermore it could help to elucidate and compare the changes in OHRQoL over time from acute TDI to their impact over the longer term as already reported in the permanent dentition (33,34).

In conclusion, enamel fracture in primary dentition does not impact on OHRQoL, suggesting that studies that aim to quantify the impact of TDI on quality of life should analyze enamel fracture separately or in the category of no TDI. From the clinical point of view, the lack of impact of enamel fracture on the scores of all domains of quality of life also suggests that restorative treatment is unlikely to be justifiable if undertaken to improve the child's quality of life. However these findings are based on a population study and treatment decisions should be made on an individual patient basis.

REFERENCES:

1. Petersen PE, Kwan S. Evaluation of community-based oral health promotion and oral disease prevention – WHO recommendations for improved evidence in public health practice. Community Dent Health 2004: 21(4 Suppl): 319-29.
2. Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Bönecker M, Raggio DP. Impact of oral diseases and disorders on oral health-related quality of life of preschool children. Comm Dent Oral Epidemiol 2011; 39: 105-14.
3. Viegas CM, Scarpelli AC, Carvalho AC, Ferreira FM, Podeus IA, Paiva SM. Impact of traumatic dental injury on quality of life among Brazilian preschool children and their families. Ped Dent 2012; 34:300-6.
4. Scarpelli AC, Paiva SM, Viegas CM, Carvalho AC, Ferreira FM, Pordeus IA. Oral health-related quality of life among Brazilian preschool children. Comm Dent Oral Epidemiol 2013; 41: 336-44.
5. Kramer PF, Zembruski C, Ferreira SH, Feldens CA. Traumatic dental injuries in Brazilian preschool children. Dent Traumatol 2003;19:299-303.
6. Oliveira LB, Marcenes W, Ardenghi TM, Sheiham A, Bönecker M. Traumatic dental injuries and associated factors among Brazilian preschool children. Dent Traumatol 2007;23:76-81
7. Hasan AA, Qudeimat MA, Andersson L. Prevalence of traumatic dental injuries in preschool children in Kuwait - a screening study. Dent Traumatol 2010;26:346-50.
8. Feldens CA, Kramer PF, Feldens EG, Pacheco LM, Vítolo MR. Socioeconomic, behavioral, and anthropometric risk factors for traumatic dental injuries in childhood: a cohort study. Int J Paediatr Dent 2014;24:234-43.
9. Güngör HC. Management of crown-related fractures in children: an update review. Dent Traumatol 2014; 30:88-99.
10. Aldrigui JM, Cadioli IC, Mendes FM, Antunes JL, Wanderley MT. Predictive factors for pulp necrosis in traumatized primary incisors: a longitudinal study. Int J Paediatr Dent 2013;23:460-9.

11. Guyatt GH, Sackett DL, Cook DJ. Users' guides to the medical literature. II. How to use an article about therapy or prevention. B. What were the results and will they help me in caring for my patients? Evidence-Based Medicine Working Group. JAMA 1994; 271:59-63.

12. International Association of Dental Traumatology. Dental Trauma Guide. Available at < http://www.dentaltraumaguide.org/> [Accessed 07 Dec 2014].

13. Malmgren B, Andreasen JO, Flores MT, Robertson A, DiAngelis AJ, Andersson L et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. Dent Traumatol 2012;28:174-82.

14. Pahel BT, Rozier RG, Slade GD. Parental perceptions of children`s oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). Health Qual Life Outcomes 2007; 5:6.

15. Tesch FC, Oliveira BH, Leão A. Semantic equivalence of the Brazilian version of the Early Childhood Oral Health Impact Scale. Cad Saúde Públ 2008; 24: 1897-909.

16. Terwee CB, Dekker FW, Wiersinga WM, Prummel MF, Bossuyt PM. On assessing responsiveness of health-related quality of life instruments: guidelines for instrument evaluation. Qual Life Res 2003;12:349-62.

17. Kramer PF, Feldens CA, Bruch CM, Ferreira SH, Feldens EG. Clarifying the effect of behavioral and clinical factors on traumatic dental injuries in childhood: a hierarchical approach. Dent Traumatol 2015 (In Press).

18. World Health Organization. Oral Health Surveys, Basic Methods, 4th ed. Geneve: World Health Organization, 1997.

19. Andreasen JO, Andreasen FM, Andersson L, editors. Textbook and color atlas of traumatic injuries to the teeth, 4th edn. Oxford: Blackwell; 2007. p. 217–54.

20. Bratthal D. Introducing the significant caries index together with a proposal for a new global oral health goal for 12-year-old. Int Dent J 2000; 50:378-84.

21. Foster TD, Hamilton MC. Occlusion in the primary dentition. Br Dent J 1969; 126: 76-79.

22. Grabowski R, Sthal F, Gaebel M, Kundt G. Relationship between occlusal findings and orofacial myofunctional status in primary and mixed dentition. Part 1: Prevalence and malocclusions. J Orofac Orthop 2007; 68:26-37.

23. Glantz GA. Primer of biostatistics. New York, NY: McGraw-Hill Co, 1997: 313-14.

24. Kramer PF, Feldens CA, Helena Ferreira S, Bervian J, Rodrigues PH, Peres MA. Exploring the impact of oral diseases and disorders on quality of life of preschool children. Community Dent Oral Epidemiol 2013; 41:327-35.

25. Aldrigui JM, Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Bönecker M et al. Impact of traumatic dental injuries and malocclusions on quality of life of young children. Health Qual Life Outcomes 2011; 9:78.

26. Viegas CM, Paiva SM, Carvalho AC, Scarpelli AC, Ferreira FM, Pordeus IA. Influence of traumatic dental injury on quality of life of Brazilian preschool children and their families. Dent Traumatol 2014; 30:338-347.

27. Gomes MC, Pinto-Sarmento TC, Costa EM, Martins CC, Granville-Garcia AF, Paiva SM. Impact of oral health conditions on the quality of life of preschool children and their families: a cross-sectional study. Health Qual Life Outcomes 2014, 18;12:55.

28. Guedes RS, Piovesan C, Antunes JL, Mendes FM, Ardenghi TM. Assessing individual and neighborhood social factors in child oral health-related quality of life: a multilevel analysis. Qual Life Res 2014; 23:2521-30.

29. Abanto J, Tello G, Bonini GC, Oliveira LB, Murakami C, Bönecker M. Impact of traumatic dental injuries and malocclusion on quality of life of preschool children: a population-based study. Int J Paed Dent 2015; 25:18-28.

30. Abanto J, Tsakos G, Paiva SM, Raggio DP, Celiberti P, Bönecker M. Agreement between children aged 5-6 years and their mothers in rating child oral health-related quality of life. Int J Paediatr Dent 2014;24:373-9.

31. Ramos-Jorge ML, Ramos-Jorge J, Mota-Veloso I, Oliva KJ, Zarzar PM, Marques LS. Parents' recognition of dental trauma in their children. Dent Traumatol. 2013;29:266-71.

32. Chadwick BL, White DA, Morris AJ, Evans D, Pitts NB. Non-carious tooth conditions in children in the UK, 2003. Br Dent J 2006; 200:379-84.

33. Porritt JM, Rodd HD, Ruth Baker S. Quality of life impacts following childhood dento-alveolar trauma. Dent Traumatol 2011;27:2-9.

34. Porritt JM, Rodd HD, Baker SR. Parental quality-of-life impacts following children's dento-alveolar trauma. Dent Traumatol 2013;29:92-8.

35. Glendor U1, Halling A, Andersson L, Eilert-Petersson E. Incidence of traumatic tooth injuries in children and adolescents in the county of Västmanland, Sweden. Swed Dent J 1996;20:15-28.

36. O'Brien M. Children's dental health in the United Kingdom 1993. In: Report of dental survey, Office of Population Censuses and Surveys. London: Her Majesty's Stationery Office; 1994.

Table 1 – Impact of Traumatic Dental Injuries on Oral Health-Related Quality of Life on preschool children.

Publication		Study Design	Study Population				Data Collection		Impact on OHRQoL
Author	Journal*		Sample	Country	N	Age	Instrument	Criteria**	
Abanto et al., (2011)[2]	CDOE	Cross-Sectional	Dental School	Brazil (SP)	260	2–5	ECOHIS	Y/N (Andreasen)	N
Aldrigui et al. (2011)[24]	HQLO							Complicated/ Uncomplicated (Glendor)	Complicated: Y Uncomplicated: No
Viegas et al. (2012)[3]	PD	Cross-Sectional	Preschool	Brazil (MG)	388	5	ECOHIS	Y/N (Andreasen)	N
Kramer et al. (2013)[24]	CDOE	Cross-Sectional	Preschool	Brazil (RS)	1036	2–5	ECOHIS	Y/N (Andreasen)	Y
Scarpelli et al. (2013)[4]	CDOE	Cross-Sectional	Preschool	Brazil (MG)	1632	5	ECOHIS	Y/N (Andreasen)	N
Viegas et al. (2014)[26]	DT							Type of TDI (Andreasen)	Y (avulsion on CIS and FIS; discoloration on FIS)
Gomes et al. (2014)[27]	HQLO	Cross-Sectional	Preschool	Brazil (PB)	843	3-5	ECOHIS	Y/N (Andreasen)	Y (only on CIS)
								Type of TDI (Andreasen)	Y (avulsion and luxation only on FIS)
Guedes et al. (2014)[28]	QLR	Cross-Sectional	Preschool	Brazil (RS)	478	1-5	ECOHIS	Y/N (O'Brien)	Y
Abanto et al. (2015)[29]	IJPD	Cross-Sectional	Vaccination Campaign	Brazil (SP)	1215	1–4	ECOHIS	Complicated/ Uncomplicated (Glendor)	Complicated: Y Uncomplicated: No

* CDOE: Community Dentistry and Oral Epidemiology; HQLO: Health and Quality of Life Outcomes; PD: Pediatric Dentistry; DT: Dental Traumatology: IJPD: International Journal of Paediatric Dentistry; QLR: Quality of Life Research.

**Criteria: Andreasen (18), Glendor (35) and O'Brien (36).

Table 2 – Sociodemographic and clinical characteristics of the sampled children.

Variables	N	(%)
Sex		
Male	663	(52.0)
Female	612	(48.0)
Age		
1 year	166	(13.0)
2 years	234	(18.4)
3 years	318	(24.9)
4 years	343	(26.9)
5 years	214	(16.8)
Mother's age		
< 20 years	115	(9.2)
20 – 35 years	986	(78.7)
> 35 years	116	(12.1)
Mother's education		
< 9 years	449	(36.2)
9 - 11 years	676	(54.4)
> 11 years	117	(9.4)
Family structure		
Nuclear	826	(64.8)
Non-nuclear	449	(35.2)
Number of people living at the child's home		
< 4	440	(34.5)
4 to 5	648	(50.8)
> 5	187	(14.7)
Dental Caries		
Caries Free (dmft=0)	980	(76.9)
Low Severity (dmft 1-4)	198	(15.5)
High Severity (dmft > 4)	97	(7.6)
Malocclusion		
Absence	460	(36.1)
Presence	815	(63.9)
Dental Trauma		
Absence	1104	(86.6)
Presence	171	(13.4)

Table 3 – Mean difference between types of TDI for overall ECOHIS and ECOHIS≥1 (n=1,275).

Condition	N	ECOHIS		p*	ECOHIS≥1		p**
		Mean	(SD)		N	(%)	
Overall	1275	0.82	(2.87)		222	(17.4)	
TDI				<0.001			<0.001
Without	1104	0.75	(2.70)		174	(15.8)	
Enamel fracture	68	0.63	(1.98)		11	(16.2)	
Crown discoloration	64	1.30	(2.87)		19	(29.7)	
Enamel/dentine fracture	24	2.58	(7.73)		7	(29.2)	
Avulsion	15	2.62	(2.99)		11	(73.3)	

*Kruskal-Wallis test; ** Chi-square test

Table 4 – Mean difference between children without TDI, enamel fracture and other TDI for each domain and for overall ECOHIS (*n*=1,275).

Oral clinical condition	Child Impact Section								Family Impact Section				ECOHIS	
	SD		FD		PD		SSD		PDD		FFD			
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Overall	0.16	(0.50)	0.25	(1.04)	0.12	(0.58)	0.04	(0.36)	0.17	(0.83)	0.09	(0.47)	0.82	(2.86)
TDI														
Without	0.13 [A]	(0.48)	0.21 [A]	(0.94)	0.11 [A]	(0.56)	0.04 [A]	(0.03)	0.17 [A]	(0.84)	0.08 [A]	(0.46)	0.74 [A]	(2.70)
Enamel fract	0.13 [A]	(0.42)	0.32 [A]	(1.18)	0.07 [A]	(0.31)	0.03 [A]	(0.24)	0.06 [A]	(0.29)	0.01 [A]	(0.12)	0.63 [A]	(1.98)
Other TDI*	0.41 [B]	(0.75)	0.57 [B]	(1.74)	0.18 [A]	(0.88)	0.11 [A]	(0.62)	0.30 [B]	(1.04)	0.22 [B]	(0.66)	1.79 [B]	(4.49)
p-value**	<0.001		0.017		0.671		0.654		0.028		<0.001		<0.001	

ECOHIS, Early Childhood Oral Health Impact Scale; SD = Symptom Domain; FD = Function Domain; PD = Psychological Domain; SSD = Self-image/Social Interaction Domain; PDD = Parent Distress Domain; FFD = Family Function Domain.

* Other TDI: Enamel/Dentin fracture, crown discoloration and avulsion.

**Kruskal-Wallis test; Values in the column with different letters indicate significant differences at $p<0.017$, based on Bonferroni post hoc comparison test.

Table 5 - Unadjusted and Adjusted prevalence ratio of the association between ECOHIS scores, ECOHIS ≥1 and TDI variables; Poisson regression analysis; (*n*=1,275).

Variable	N	ECOHIS scores		ECOHIS≥1		p	Unadjusted		Adjusted*		
		Mean	(SD)	n	(%)		PR	95% CI P	PR	95% CI	P*
Outcome: All TDI (including enamel fracture)						<0.001					
No	1104	0.75	(2.70)	174	(15.8)		1.00		1.00		
Yes	171	1.33	(3.74)	48	(28.1)		1.78	(1.35-2.35)	1.59	(1.20-2.10)	0.001
Outcome: TDI excluding enamel fracture						<0.001					
No	1172	0.74	(2.66)	185	(15.8)		1.00		1.00		
Yes	103	1.79	(4.49)	37	(35.9)		2.28	(1.70-3.04)	1.86	(1.39-2.50)	<0.001
TDI 3 categories						<0.001					
No	1104	0.74	(2.70)	174	(15.8)		1.00		1.00		
E fracture	68	0.63	(1.98)	11	(16.2)		1.03	(0.59-1.79)	1.10	(0.62-1.93)	0.753
Other TDI	103	1.79	(4.49)	37	(35.9)		2.28	(1.70-3.05)	1.87	(1.39-2.52)	<0.001

* Adjusted for age, malocclusion, use of dental service and dental caries