

**Oral Health Related Quality of Life of Preschoolers with Severe Caries
After Dental Rehabilitation under General Anesthesia**

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Abstract:

Purpose: To determine changes in the oral-health related quality of life (OHRQoL) of preschool-aged children with severe early childhood caries (S-ECC) following dental surgery under general anesthesia (GA). **Methods:** Parents/caregivers completed a questionnaire including the Early Childhood Oral Health Impact Scale (ECOHIS). Data analysis included descriptive statistics, bivariate analyses, effect size, and multiple linear regression. A p value ≤ 0.05 was significant.

Results: Overall, 150 children were enrolled; mean age 47.7 ± 14.2 months and 52% female. Mean total ECOHIS score was 6.3 ± 5.3 . Higher scores (more negative OHRQoL) were associated with single parent and low income households ($< \$28,000/\text{year}$), higher dmft scores, and having dental extractions ($p \leq 0.05$). Low household income ($p = 0.01$) and the child not having registered First Nation status ($p = 0.03$) were significantly and independently associated with higher total baseline ECOHIS scores. The 103 follow-up children had a mean baseline total ECOHIS score of 6.27 ± 5.4 and follow-up of 3.48 ± 2.9 . Change in total ECOHIS and three of four Child Impact Section domains (symptoms, function, and psychological) showed significant improvement ($p < 0.001$). Symptoms and psychological domains demonstrated a moderate effect size; 0.66 and 0.56 respectively. No significant improvements were observed in the Family Impact Section; effect size (0.03). Follow-up ECOHIS scores were associated with low income households ($< \$28,000/\text{year}$) ($p = 0.01$) and not having registered First Nation status ($p = 0.03$).

Conclusion: Significant improvements in OHRQoL were observed following dental surgery. ECOHIS could be used as a tool to help prioritize children waiting for dental surgery under GA.

Introduction:

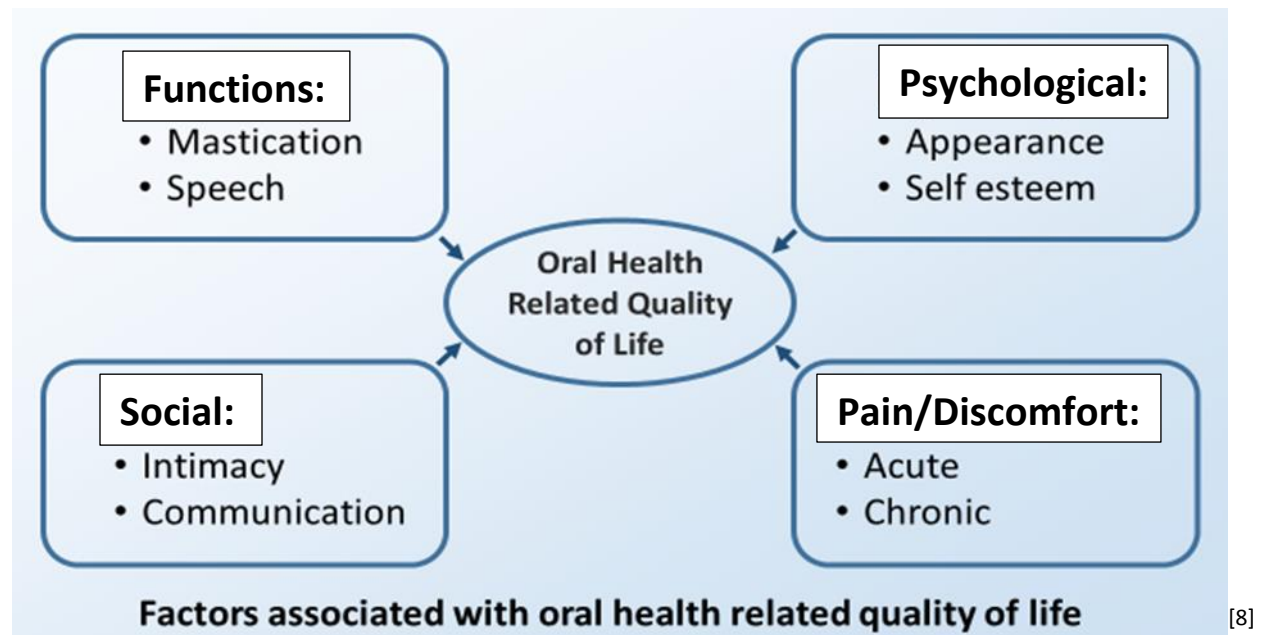
Dental caries is the most common chronic disease of childhood. The American Academy of Pediatric Dentistry (AAPD) defines early childhood caries (ECC) as the presence of one or more decayed, missing, or filled tooth surfaces in primary teeth in children < 72 months of age. An advanced form, severe early childhood caries (S-ECC), is at epidemic levels in many areas of the world, including Canada.[1] Children with S-ECC often require dental rehabilitation under general anesthesia (DRGA) and it is the most frequent hospital day surgery for preschoolers in North America.[2] Dental infections and pain associated with S-ECC can affect eating patterns, sleep, [3] health and well-being, and the child's and family's overall quality of life.[4]

Before the introduction of oral health related quality of life (OHRQoL) determinants, patients' dental experiences were measured based on clinical success.[5] OHRQoL introduced the idea of psychological and social aspects to be considered along with physical aspects of oral disease.[6] The use of patient-focused assessments of the impact of oral disease on their psychological and social well-being compliment clinical exams and help determine the full impact of oral conditions on patients' mental and emotional well-being.[7]

Four factors are associated with the current OHRQoL mode [Figure 1]:

1. Experience of Pain/Discomfort
2. Functional Factors (ability to bite, chew, swallow, or speak)
3. Psychological Factors
4. Social Factors (comfort level when eating or speaking in front of others)[8]

Figure 1 – Factors associated with OHRQoL



The purpose of this study was to determine the OHRQoL of preschool children before and after DRGA to treat S-ECC.

Methods:

This study was part of a larger prospective investigation examining changes in nutritional status, blood values, and well-being following DRGA. Children were enrolled in the study over a 15 month period (November 2015 - January 2017).

Inclusion Criteria:

1. Children 24 -- 72 months of age (when determination made for DRGA)
2. Children undergoing DRGA for S-ECC
3. Children residing within an two hour drive of Winnipeg

Exclusion Criteria:

1. Children undergoing dental surgery for conditions other than S-ECC
2. Children with an existing chronic disease other than S-ECC

Written informed consent was obtained, and the child's parent/caregiver completed an interview-led questionnaire asking a series of questions pertaining to the child's general health, OHRQoL, dietary habits, household income, dental insurance, and family demographics. Children's baseline dmft and dmfs (cumulative count of number of decayed, missing due to caries, filled teeth/surfaces) scores were calculated from the operative reports.

The Early Childhood Oral Health Impact Scale (ECOHIS) was used to measure OHRQoL. ECOHIS is a parental/caregiver proxy questionnaire which has construct validity, internal consistency, and reliability for measuring OHRQoL in preschool aged children.[9] ECOHIS was developed for epidemiological surveys and validated with five year old children, initially to assess the burden and then later, to investigate the treatment of dental disease.[9]

ECOHIS consists of 13 questions grouped into two sections:

- 1) Child impact Section (CIS)
- 2) Family impact Section (FIS)

The Child Impact Section has nine questions categorized into four domains:

1. Child's symptoms (1 question)
2. Child functions (4 questions)
3. Child psychology (2 questions)
4. Child's self-image/social interaction (2 questions).

The Family Impact Section has four questions and covers two domains:

1. Parental distress (2 questions)
2. Family function (2 questions).[9]

As per ECOHIS protocol, each question was scored on scale from 0 to 5 (0=never, 1=hardly ever, 2=occasionally, 3=often, 4=very often, 5=don't know). A total score for each child was calculated by summing up response codes. Higher scores indicated a greater oral health impact, (ie. a more negative OHRQoL). "Don't know" responses were recorded as "missing data". For those with up to two "missing"/"don't know" responses in the child impact section or one missing in the family impact section, a score for the missing items was imputed as an average of the remaining items for that section. If the CIS had more than two "missing" responses or the FIS more than one "missing" response that section was excluded. Total ECOHIS maximum score is 52.[9]

ECOHIS was originally developed as a self-answered parent-proxy questionnaire; but in our study it was administered by interview. Taskos (2012) reported no bias when comparing self-administered to interviewer lead child OHRQoL questionnaires.[9-11]

A minimum three-month and maximum twelve-month post-surgery follow-up period was selected to provide sufficient time for recovery from surgery and to provide an opportunity for the child to establish a regular dietary routine and regain proper chewing function. The follow-up visit was at the Children's Hospital Research Institute of Manitoba (CHRIM).

The study was approved by the University of Manitoba's Health Research Ethics Board and the Misericordia Health Centre Research Committee. All children met the study criteria and the AAPD case definition for S-ECC.[1]

Clinical and questionnaire data were entered into an Excel (Microsoft Office) database and analyzed using Number Cruncher Statistical Software (NCS-12) and Statistical Package for the Social Sciences software (SPSS). Data analysis included descriptive statistics (frequencies, percentages, and means \pm SD)). Bi-variate tests included the standard two sample t-test and chi square analysis. Multiple linear regression analyses were also performed. P value \leq 0.05 was significant. The magnitude of change was determined through effect size, which is the difference between baseline and follow-up mean scores divided by the baseline SD.[12] It is a distribution-based measurement that can be interpreted as a small (<0.2), moderate ($0.2-0.7$), or large (>0.7) value.[12]

Results

Sociodemographic / Clinical Presentation

Overall, 150 children were recruited with a mean age 47.7 ± 14.2 months, 52% female. [Table 1]. The majority (63.3%) resided in the urban centre of Winnipeg. Additionally, many parents (58%) reported an annual household income less than Statistics Canada's 2016 Market Basket Measure (MBM) for a family \leq 4 living in Manitoba. MBM is a threshold measurement of low income based on the cost of food, clothing, transportation, and shelter specific to a geographic area of Canada.[13] The mean dmft score was 10.3 ± 3.4 , and the mean dmfs score was 40.1 ± 17.5 .

Baseline ECOHIS (n=150)

The mean total ECOHIS score at baseline was 6.2 ± 5.2 (range 0-30) while the mean CIS and FIS scores were 4.2 ± 4.2 (range 0-24) and 2.0 ± 2.1 (range 0-8), respectively [Table 2]. The most notable ECOHIS responses were in the CIS where 57% of children experienced mouth pain (Q1) and 34% had difficulty eating “occasionally”, “often”, or “very often”. Additionally, 37% expressed frustration/irritation (Q7) “occasionally”, “often”, or “very often”. In the FIS, 32% of parents were upset with their child’s dental condition (Q10) and 43% of parents/caregivers reported feeling guilt (Q11) “occasionally” or more. “Don’t know” responses were taken into account according to ECOHIS parameters; but, no participants or participant impact sections were excluded due to over frequency of “don’t know” responses.

Univariate analysis revealed that higher mean total baseline ECOHIS scores (i.e., more negative OHRQoL) were significantly associated with single parent families ($p=0.05$), low household income ($< \$28,000/\text{year}$) ($p=0.01$), higher dmft scores ($p=0.05$), and having dental treatment that included extractions ($p=0.01$). However, there was no association with a child being registered First Nations or not ($p=0.38$). Looking at the CIS, as found with total ECOHIS, baseline scores were significantly associated with single parent families, household income, and extractions. Males also had significantly higher CIS scores ($p=0.04$). However, unlike total ECOHIS scores, there was not a significant association between dmft and CIS ($p=0.07$). No significant associations were observed with baseline FIS scores.

Multiple linear regression revealed that two covariates were significantly and independently associated with total ECOHIS, low household income ($p=0.01$) and the child not having registered First Nation status ($p=0.03$). Children from families with low household

income and non-registered First Nation children had average total ECOHIS scores that were 2.43 and 2.11 times higher for each unit increase in ECOHIS score [Table 3a].

Out of the 150 children enrolled in the study 106 children returned (70.1%) to complete the study with 3 excluded from follow-up as they returned >12 months post-surgery. Table 3b shows multiple linear regression for the 103 returning children and follow-up total ECOHIS score. As with the 150 baseline participants, the two notable covariates associated with follow-up total ECOHIS were low household income ($p=0.01$) and the child not having registered First Nation status ($p=0.03$).

Comparison between Baseline and Follow-up ECOHIS Scores [Table 4]

Baseline and follow-up ECOHIS responses for the 103 children completing both phases appear in Table 4. There were no statistically significant differences in the sociodemographic/clinical characteristics or baseline ECOHIS scores between the baseline 150 participants and the 103 follow-up participants. Those who returned and those lost to follow-up did not differ by age ($p=0.58$), parental education level ($p=0.37$), annual household income ($p=0.79$), CIS ($p=0.57$), FIS ($p=0.22$), total ECOHIS ($p=0.97$), or dmfs ($p=0.63$). However, there was a statistically significant difference between those returning and those lost to follow-up based on where families resided; those living outside of Winnipeg were more likely to be lost to follow-up ($p=0.0002$).

The mean total ECOHIS at follow-up was 3.48 ± 2.93 (range 0-16). The same parent/caregiver accompanied the child at recruitment and post-surgery 92% of the time, with mothers accompanying the child 88.3% at baseline vs. 83.5% at follow-up. The timeline for the 103 follow-up children ranged from 53 to 363 days post-surgery.

Comparing baseline and follow-up scores for the 103 children who returned [Table 4], a significant decrease in scores was noted. Baseline mean total ECOHIS (6.27 ± 5.37) vs. follow-up mean total ECOHIS (3.48 ± 2.93), dropped 44.5% resulting in a medium effect size of 0.53 ($p < 0.01$). A statistically significant reduction in CIS scores between baseline and follow-up of 63.8% was also noted (4.35 ± 4.42 vs. 1.57 ± 2.12) ($p < 0.001$). However, the drop in FIS from baseline to follow-up was only 3.7% and was not significant, (1.92 ± 2.08 vs. 1.85 ± 1.95) ($p = 0.68$). At baseline, the highest scores obtained were total ECOHIS 30, CIS 24, and FIS 8 compared to total ECOHIS 16 and both CIS and FIS 11 at follow-up.

The percentage of children expressing pain at follow-up (Q1) “occasionally”, “often” or “very often” dropped to 4.9% post-treatment from 34.0% pretreatment. Children expressing feelings of frustration/irritability “occasionally”, “often” or “very often” (Q7) was 7.8% at follow-up compared to 27.2% at baseline. Parental/caregiver feelings of guilt over their child’s dental health (Q11) remained high at follow-up as 30.1% reported this “occasionally”, “often”, or “very often” compared to 27.2% at baseline. Improvements in CIS between baseline and follow-up had a medium effect size of 0.6. Overall, three of the four child impact domains (Symptoms, Function, and Psychological) showed a moderate effect size between study periods (Symptoms = 0.7, Function = 0.5, and Psychological = 0.6). The effect size for FIS was insignificant at 0.03 [Table 4].

Multiple regression analysis was undertaken to determine whether covariates were associated with changes in ECOHIS scores between baseline and follow-up phases. Only the child being male for CIS and total ECOHIS exhibited a statistically significant association (CIS $p = 0.02$ (95% CI 0.55, 2.45), Total ECOHIS $p = 0.004$ (95% CI 0.30, 2.99)).

Discussion:

Our study explored whether children's OHRQoL improves following DRGA for S-ECC. Findings revealed that there were significant improvements in mean total ECOHIS score and CIS, but not in the FIS. Similar studies around the world have also shown general improvement in OHRQoL [Table 5].[14-27]

It is important to compare our findings with those studies that included at least a three month follow-up. Lee et al.'s (2010) study found a 27.6% improvement in mean total ECOHIS score, 25.4% reduction in CIS, and 31.0% reduction in FIS three months postoperatively.[20] Pakdaman and Ghadimi (2014) (Iran) showed significant improvement in OHRQoL at the three month post DRGA follow-up. [22] Yawary et al.'s (2015) study (Australia) showed a 38.4% improvement in mean total ECOHIS, 37.8% in CIS, and 39.5% in FIS three months post GA.[24] Collado (2016) (France) found ECOHIS decreased significantly from day of dental surgery to one month post operatively ($p < 0.001$), remaining significant three months after GA ($p < 0.01$).[16] Jankauskiene's (2017) (Lithuania) study showed total ECOHIS improved one month after dental GA when compared to baseline ($p < 0.001$), and remained low at the six month dental recall ($p < 0.001$).[19] When comparing our results to international research we have to consider differences in cultural norms, parental/family effects on the OHRQoL of young children, and whether children from different locals express similar presentations and severity of S-ECC. ECOHIS responsiveness to change in dental disease may vary when used with different populations, languages, and cultures.[14-27]

It is interesting to note that in our study CIS (ECOHis \geq 1) decreased 14% (p=0.04), but FIS (ECOHis \geq 1 – noted experience) did not change (p=0.9), suggesting ongoing parental/caregiver emotions associated with their child’s dental condition months after surgery.[28] The “family function” domain (Q 12, 13) mean scores actually increased between baseline and follow-up. Answers to “How often has your child had dental problems or dental treatments that had a financial impact on your family?” (Q13) often exhibit a causal relationship to government assistance available for dental treatment. Jurisdictions around the world vary greatly in the extent to which dental treatment for children is financially subsidized.[4]

Mothers have been found to have a better understanding of their child’s OHRQoL as they are often the child’s primary caregiver.[29] In our study, mothers were more likely to participate (88.3% at and 83.5% at follow-up). Families living outside of Winnipeg were more likely to be lost to follow-up. (p=0.0002) This result was not surprising as residence location factors into convenience of attending follow-up.

Looking at sociodemographic characteristics, 58% of our study families had a low household income, below the MBM for a family of \geq 4 living in Manitoba. Twelve out of sixteen recent studies that evaluated the association of family income with children’s OHRQoL, found a significant association.[30] In univariate and multivariate analysis of participants, low household income had a statistically significant association with negative OHRQoL.[31]

Examining individual ECOHis questions [Table 4], the question “How often has your child, because of dental problems or treatment avoided smiling or laughing when around other children?” (Q8) had low baseline and follow-up ECOHis scores. Lower social awareness and

cognitive growth of 3 to 5 year olds may make them less susceptible to the influence of social factors such as not speaking or smiling. A lower initial value and minimal change post-surgery has been shown previously.[23]

Although there is a significant floor effect (large number of participants scoring at or near the lowest possible score of zero) associated with ECOHIS there were relatively higher baseline scores associated with CIS questions related to pain (Q1), difficulty drinking (Q2), difficulty eating (Q4), frustration (Q7), and the FIS questions related to feeling upset (Q10) and parental guilt (Q11).[9] These findings are similar to those in other studies where the greatest changes were found within the domains of “Symptoms”, “Function”, and “Psychological” (CIS) and “Parental Distress” (FIS). [14-27] (Table 5) Our ECOHIS scores associated with the “symptoms” domain were low compared to similar prior studies. [14-27]. Only 57% of children experienced mouth pain “occasionally”, “often”, or “very often” prior to dental surgery. This finding may support the reservations of using a proxy for reporting as the parent/caregiver may not be aware of all symptoms the child is experiencing.[32] Children <6 years of age lack abstract thinking capacity hence the reliance on parental/caregiver proxy.[9, 33] This ties into the importance of examining the “don’t know” responses to questions.[32] The parent’s/caregiver’s knowledge of their child’s internal feelings with regard to oral health may be limited.[34, 35] Parents may have different attitudes toward their children’s health compared with other parents and even their own child.[26]

As per ECOHIS’s validated protocol, the “don’t know” responses were noted and accounted for. The 103 children who completed the study had a total of 10 baseline “don’t know” responses, all involving the CIS, with 50% from the question “How often has your child

missed preschool, daycare, or school because of dental problems or dental treatments?” (Q5). This represented 4.9% of all responses to this question. The follow-up ECOHIS survey resulted in one “don’t know” response in FIS related to finances (Q 13).

To our knowledge, ECOHIS among children undergoing DRGA for S-ECC has not been studied in North America, so we have no geographically appropriate comparisons.[14-27] Outside North America, pretreatment ECOHIS scores for children with S-ECC undergoing DRGA were significantly higher than in our study and ranged from 11-27 at baseline to 1-13 at follow-up.[14-27] [Table 5] However, making direct comparisons with other studies is difficult as there are many factors that influence ECOHIS and change in scores, including extent and type of treatment provided, age of the child, and presence of pain and/or infection. [14-27]

Looking at other North American non-general anesthetic dental rehabilitation ECOHIS studies, the validated French language version of ECOHIS was used in a community dental setting in Quebec in 2008. In this study the mean total ECOHIS for parents rating their child’s oral health as “relatively poor” was 10.8.[36] Our pre-treatment total ECOHIS mean score was 6.27. Even with careful adaptation and translation of ECOHIS for use with a different population, cultural and value factors may not be properly taken into account and can affect scoring.[37] Denial or non-recognition by a parent of how their child’s dental problems are affecting their OHRQoL may exist.[3]

There is a common misperception that oral health is separate from general health.[38] Parents/caregivers may not consider oral health a component of “overall health” as evident by their response to our study’s general health question, “How would you rate your child’s overall

health?” Ninety-one percent of parents/caregivers rated their child’s “overall health” as “good” to “very good” prior to dental rehabilitation under GA compared to 93% at follow-up.

Significant dental problems expressed by high dmft and dmfs scores, need for extractions, and pulpotomies may not be strongly correlated with a more negative OHRQoL, as untreated decayed primary teeth can often remain symptom-free until lost through exfoliation[34]. Only the notable clinical measurements of dmft ($p=0.045$) and extractions ($p=0.01$) showed significant association with total ECOHIS through univariate analysis and, this was significant with only the 150 baseline participants.

Our study has limitations. This was a convenience cohort sample of 150 preschool aged children with parents willing to participate in the study. Controls were also not used. A proxy (parent/caregiver) was required to answer questions on behalf of the participant child. Parents/Caregivers generally have a low to moderate overall agreement with their child’s ratings. There is a need for child-reported measures to supplement parental/caregiver reported proxy measures. [28] Response bias is also possible.

The follow-up period varied between 53 and 363 days, and this significant range could potentially affect ECOHIS. The children seen earlier for follow-up may not have fully realized quality of life gains from the dental surgery, and the children with longer follow-up times may have started to experience OHRQoL relapse. The use of mean distribution to measure changes in health status (baseline – follow-up) does not capture variability within the study population. Attrition resulted in a 31% loss of participants at follow-up, but this was attributed to difficulties contacting parents/caregivers, refusal to return for follow-up, and transportation issues. Furthermore, it has been proposed ECOHIS oversamples certain quality of life domains and

under-samples others and has led to the recent creation and validation of new surveys to measure the OHRQoL of preschool age children.[8, 11, 31]

Parents/caregivers have their own quality of life perceptions regarding their children's health that greatly influence treatment decisions.[33] Parents' reports of child's OHRQoL and its effects on family may be influenced by characteristics such as personality and family functioning. Parents/caregivers may have different attitudes toward their child's health compared with other parents and even their own child.[26]

Our results have lower "don't know" responses than other ECOHIS studies; [14-27] This might be related to being an "interview-lead survey" rather than parent/caregiver's having a better knowledge of how their child's oral health is affecting a specific quality of life domain.[38] However, it has been shown as long as the same method of data collection is used at baseline and follow-up, self-completed or interviewer lead, reliable results are obtained.[9, 10]

This study also had several strengths. This was the first time OHRQoL was examined pre/post DRGA for S-ECC in Canada using ECOHIS. It had a prospective design, was adequately powered, and used a validated scale that has internal consistency and reliability.

Conclusion

Measurable, long-term improvements in OHRQoL were noted after dental rehabilitation. The changes in ECOHIS scores and even responses to individual questions, pre and post-treatment reflect improvement in OHRQoL and a moderate improvement effect was noted with child symptoms (pain), child function (drinking and eating), and child psychological domains (sleeping and frustration).

S-ECC is not only a clinical disease. Sociology and psychology also have a role to play in recognizing and treating S-ECC and its impacts on OHRQoL.[39] S-ECC negatively affects the quality of life of children and their families supporting the importance of implementing OHRQoL measurements. However, there may be cultural differences on how S-ECC impacts OHRQoL and the responsiveness of existing parent-proxy scales.[40]

ECOHIS could be used in a clinic setting during the consult appointment for DRGA, focusing on the questions in the CIS to ask parents/caregivers of preschool aged children to acquire a sense of the child's OHRQoL. It may be useful to incorporate the ECOHIS score into the assessment of the urgency of dental treatment and help determine prioritization on DRGA wait list.

Table 1 – Characteristics of children and their parent/caregivers

Child Characteristics		N (%)	95% CI
Sex	Male	72 (48.0)	0.40, 0.56
Rating of Child's Health	Poor	1 (0.7)	0.001, 0.04
	Fair	9 (6.0)	0.032, 0.11
	Good	65 (43.3)	0.36, 0.11
	Very Good	75 (50.0)	0.42, 0.58
Registered First Nation	Yes	86 (57.3)	0.49, 0.65
		Mean (±SD)	95% CI
Age (months)		47.7 ± 14.2	45.40, 50.00
dmft		10.3 ± 3.4	9.72, 10.86
dmfs		40.1 ± 17.5	37.20, 43.00
Number of Restored Surfaces (Combined fillings and SSC)		31.9 ± 13.8	29.59, 34.17
Number of Stainless Steel Crowns		5.9 ± 3.3	5.32, 6.38
Number of Pulpotomies (range 0-9)		1.5 ± 1.9	1.13, 1.79
Number of Extractions (range 0-9)		1.9 ± 2.2	1.53, 2.24
Family Characteristics		N (%)	95% CI
Parent/Caregiver	Father	13 (8.7)	0.05, 0.14
	Mother	129 (86.0)	0.80, 0.91
	Other (Non Parental Relative or Foster Parent)	8 (5.3)	0.03, 0.11
Single Parent Family	Yes	72 (48.0)	0.40, 0.56
	No	78 (52.0)	0.44, 0.60
Place of Residence	Urban	95 (63.3)	0.55, 0.71
Annual Household Income	<\$28,000	87 (58.0)	0.50, 0.65
	>\$28,000	54 (36.0)	0.29, 0.44
	Declined to answer	9 (6.0)	0.03, 0.11
Education Level of Parent/Caregiver	< high school	46 (30.7)	0.24, 0.38
	≥ high school	103 (68.6)	0.61, 0.76
	Declined to answer	1 (0.7)	0.001, 0.04

Dental Coverage	YES	144 (96.0)	0.92, 0.98
	No	4 (2.7)	0.01, 0.07
	Don't Know	2 (1.3)	0.004, 0.05
Type of Dental Coverage			
	Non-Insured Health Benefits (registered First Nations)	62 (41.3)	0.34, 0.49
	Insurance Provided by Employer Employment & Income Assistance	27 (18.0)	0.13, 0.25
	Private Insurance Plan	1 (0.7)	0.001, 0.04
	Multiple Insurance Sources	29 (19.4)	0.14, 0.26

Table 2 – Baseline ECOHIS Scores for all recruited children

CHILD IMPACT SECTION Questions	Mean (SD)	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Child Symptoms: <i>Question one</i>	1.19 (1.19)						
1) Oral/dental pain		57 (38.0)	35 (23.3)	38 (25.3)	13 (8.7)	6 (4.0)	1 (0.7)
Child Functions: <i>Question two - five</i>	1.89 (2.40)						
2) Difficulty drinking		116 (77.3)	12 (8.0)	12 (8.0)	9 (6.0)	1 (0.7)	0
3) Difficulty eating		96 (64.0)	20 (13.3)	20 (13.3)	12 (8.0)	2 (1.3)	0 (0)
4) Difficulty pronouncing words		123 (82.0)	7 (4.7)	7 (4.7)	5 (3.3)	4 (2.7)	4 (2.7)
5) Missed preschool or school		105 (70.0)	37 (24.7)	2 (1.3)	0 (0)	0 (0)	6 (4.0)
Child Psychological: <i>Question six and seven</i>	1.07 (1.52)						
6) Trouble sleeping		117 (78.0)	15 (10.0)	16 (10.7)	2 (1.3)	0 (0)	0
7) Irritable or frustrated		99 (66.0)	14 (9.3)	19 (12.7)	12 (8.0)	6 (4.0)	0
Child Self Image/ Social Interaction: <i>Question eight and nine</i>	0.11 (0.47)						
8) Avoid Smiling or laughing		144 (96.0)	4 (2.7)	1 (0.7)	1 (0.7)	0	0
9) Avoided talking		147 (98.0)	0 (0)	2 (1.3)	1 (0.7)	0	0
Child Impact Section <i>Question one through nine</i>	4.18 (4.17)						
FAMILY							
Parental Distress: <i>Question ten and eleven</i>	1.44 (1.83)						
10) Been upset		99 (66.0)	19 (12.7)	23 (15.3)	7 (4.7)	2 (1.3)	0
11) Felt guilty		87 (58.0)	19 (12.7)	29 (19.3)	11 (7.3)	3 (2.0)	1 (0.7)

Family Function: <i>Question twelve and thirteen</i>	0.57 (0.91)						
12) Time off work		99 (66.0)	36 (24.0)	12 (8.0)	3 (2.0)	0	0
13) Financial impact		141 (94.0)	3 (2.0)	4 (2.7)	2 (1.3)	0	0
Family Impact Section <i>Question ten through thirteen</i>	2.02 (2.10)						
Total ECOHIS Score <i>Question one through thirteen</i>	6.27 (5.26)						

Table 3a – Multiple linear regression for baseline total ECOHIS scores (n=150)

Variable	Slope	95% CI	Adj. p Value
Sex male (ref female)	1.32	-0.51, 3.15	0.16
Age (mths)	0.00	-0.06, 0.06	0.96
General health Good Very Good (ref fair/poor health)	-0.15 -0.28	-4.06, 3.75 -4.14, 3.57	0.98 0.88
Education ≥High school (ref < High school)	-0.84	-2.77, 1.09	0.39
Household Income <\$28K/y Declined to Answer (ref >\$28K)	2.43 -2.41	0.30, 4.57 -6.29, 1.47	0.01 0.22
Single parent family (ref No)	0.79	-1.13, 2.71	0.42
Non-Reg. First Nation (ref Reg. First Nation)	2.11	0.17, 4.05	0.03
dmfs	0.04	-0.01, 0.10	0.13

Table 3b – Multiple linear regression for follow-up total ECOHIS scores (n=103)

Variable	Slope	95% CI	Adj. p Value
Sex male (ref female)	1.64	0.30, 2.99	0.16
Age (mths)	0.00	-0.04, 0.05	0.96
General health Good Very Good (ref fair/poor health)	0.35 0.42	-2.01, 2.70 -1.86, 2.70	0.98 0.72
Education ≥High school (ref < High school)	0.70	-0.66, 2.05	0.39
Household Income <\$28K/y Declined to Answer (ref >\$28K)	0.04 -0.35	-1.48, 1.56 -3.02, 2.31	0.01 0.79
Single parent family (ref No)	0.40	-1.03, 1.83	0.42
Non-Reg. First Nation (ref Reg. First Nation)	1.32	-0.03, 2.66	0.03
dmfs	0.00	-0.04, 0.04	0.13

Table 4 – Comparison between baseline and follow-up ECOHIS scores for children completing the study

CHILD IMPACT SECTION	BASELINE (N=103)							FOLLOW-UP (N=103)							p val	Eff Size		
	Mean (±SD)	Never N (%)	Hardly Ever N (%)	Occasionally N (%)	Often N (%)	Very Often N (%)	Don't Know N (%)	Mean (±SD)	Never N (%)	Hardly Ever N (%)	Occasionally N (%)	Often N (%)	Very Often N (%)	Don't Know N (%)				
Child Symptoms: <i>Question one</i>	1.15 (1.22)								0.34 (0.57)								<0.001	0.7
1) Oral/dental pain		41 (39.8)	26 (25.2)	23 (22.3)	7 (6.8)	5 (4.9)	1 (1.0)		73 (70.8)	25 (24.3)	5 (4.9)	0	0	0				
Child Functions: <i>Questions two through five</i>	1.94 (2.46)								0.76 (1.20)								<0.001	0.5
2) Difficulty drinking		78 (75.7)	9 (8.7)	9 (8.7)	6 (5.8)	1 (1.0)	0		99 (96.12)	1 (1.0)	3 (2.9)	0	0	0				
3) Difficulty eating		64 (62.1)	15 (14.6)	14 (13.6)	8 (7.8)	2 (1.9)	0		84 (81.6)	11 (10.7)	8 (7.8)	0	0	0				
4) Difficulty pronouncing words		83 (80.6)	5 (4.9)	6 (5.8)	3 (2.9)	2 (1.9)	4 (3.9)		88 (85.4)	4 (3.9)	8 (7.7)	1 (1.0)	2 (1.9)	0				
5) Missed preschool or school		74 (71.8)	23 (22.3)	1 (1.0)	13 (8.7)	6 (4.0)	5 (4.9)		90 (87.4)	13 (12.6)	0	0	0	0				
Child Psychological: <i>Questions six and seven</i>	1.22 (1.63)								0.33 (0.82)								<0.001	0.6
6) Trouble sleeping		76 (73.8)	14 (13.6)	11 (10.7)	2 (1.9)	0	0		98 (95.2)	4 (3.9)	0	1 (1.0)	0	0				
7) Irritable or frustrated		65 (63.1)	10 (9.7)	12 (11.7)	10 (9.7)	6 (5.8)	0		87 (84.47)	8 (7.77)	6 (5.83)	1 (0.97)	1 (0.97)	0				
Child Self Image/ Social Interaction: <i>Questions eight and nine</i>	0.41 (0.55)								0.14 (0.83)								0.40	0
8) Avoid Smiling or laughing		98 (95.2)	3 (2.9)	1 (1.0)	1 (1.0)	0	0		98 (95.2)	4 (3.9)	0	0	1 (1.0)	0				
9) Avoided talking		100 (97.1)	0	2 (1.9)	1 (1.0)	0	0		100 (97.1)	1 (1.0)	1 (1.0)	0	1 (1.0)	0				
CHILD SECTION <i>Questions one through nine</i>	4.35 (4.42)								1.57 (2.12)								<0.001	0.6

FAMILY IMPACT SECTION	BASELINE							FOLLOW-UP							p val	Eff Size
	Mean (SD)	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know	Mean (SD)	Never	Hardly Ever	Occasionally	Often	Very Often	Don't Know		
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
Parental Distress: <i>Questions ten and eleven</i>	1.40 (1.88)							1.22 (1.53)							0.43	0.09
10) Been upset		70 (68.0)	12 (11.7)	14 (13.6)	6 (5.8)	1 (1.0)	0		80 (77.7)	15 (14.6)	6 (5.8)	2 (1.9)	0	0		
11) Felt guilty		61 (59.2)	14 (13.6)	18 (17.5)	8 (7.8)	2 (1.9)	0		53 (51.5)	19 (18.5)	22 (21.4)	6 (5.8)	3 (2.9)	0		
Family Function: <i>Questions twelve and thirteen</i>	0.52 (0.78)							0.68 (1.08)							0.33	-0.1
12) Time off work		67 (65.1)	27 (26.2)	8 (7.8)	1 (1.0)	0	0		73 (70.9)	20 (19.4)	8 (7.7)	2 (1.9)	0	0		
13) Financial impact		98 (95.1)	3 (2.9)	1 (1.0)	1 (1.0)	0	0		88 (85.4)	7 (6.8)	6 (5.8)	0	1 (1.0)	1 (1.0)		
Family Section <i>Question ten through thirteen</i>	1.92 (2.08)		1.85 (1.95)		0.68	0.03									0.68	0.03
Total ECOHIS Score <i>Questions one through thirteen</i>	6.27 (5.37)							3.48 (2.93)							<0.001	0.53

Table 5 – ECOHIS and dental rehabilitation under general anesthesia around the world

PUB Year	AUTHOR	SIZE OF STUDY GENDER MEAN AGE OF CHILDREN	STUDY'S HOSPITAL CITY AND COUNTRY	TOTAL ECOHIS MEAN PRE GA	TOTAL ECOHIS MEAN POST GA	STUDY CONCLUSION
2009	Klaassen et al.[27]	104 PARTICIPANTS 51.9% BOYS AGE 4.08Y	PEDIATRIC DENTAL CLINICS, AMSTERDAM, NETHERLANDS	PRIOR TO GA 12.89 (+/-6.39)	1 MONTH POST GA 7.38 (+/-7.0)	SHOWED AN IMPROVEMENT IN ORAL-HEALTH REALTED QUALITY OF LIFE FOLLOWING GA
2011	LEE et al.[20]	32 PARTICIPANTS 53.1% BOYS AGE 54.1 Months	UNIVERSITY OF HONG KONG HOSPITAL, HONG KONG(SRA), CHINA	DAY PRIOR TO GA 18.5 (+/- 18.5)	3 MONTHS POST GA 13.4 (+/-6.7)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASES IN ECOHIS (p<0.01)
2014	JANKAUSKIENE et al.[18]	140 INITIAL PARTICIPANTS 54.9% BOYS AGE 3.9Y 122 FOLLOW-UP PARTICIPANTS (84.7% FOLLOW-UP RATE)	UNIVERISTY OF HEALTH SCIENCES HOSPITAL, KAUNAS, LITHUANIA	21.7 (MALE) 18.9 (FEMALE)	1 MONTH POST GA 6.5 (+/-4.8)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASES IN ECOHIS (p<0.01)
2014	PAKDAMAN and GHADIMI[22]	81 INITIAL PARTICIPANTS	3 DIFFERENT HOSPITALS / CLINICS, TEHRAN, IRAN	CHILD SECTION 10.88 (+/-7.6) FAMILY SECTION 9.5 (+/-3.5)	1 MTH POST GA CHILD SECT 0.98 (+/2.3) FAMILY SECT 2.4(+/- 2.2) 3 MNTH POST GA CHILD SECT 0.4 (+/0.2) FAMILY SECT 0.8(+/-1.3)	SHOWED SIGNIFICANT IMPROVEMENT IN OHRQoL FOLLOWING GA
2014	ALMAZ et al.[14]	120 INITIAL PARTICIPANTS 67.3% BOYS AGE 50.8MONTHS 98 FOLLOW-UP PARTICIPANTS (81.6% FOLLOW-UP RATE)	KIRRIKALE UNIVERSITY, KIRRIKALE, TURKEY	DAY OF GA 19.2 (+/-8.3)	1 MONTH POST GA 8.7 (+/-7.2)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS (P<=0.001)
2014	CANTEKIN et al.[15]	311 FINAL PARTICIPANTS 51%BOYS AGE 5.03Y	ERCIYES UNIVERISTY, KAYSERI, TURKEY	DAY OF GA 20.6 (+/-8.1)	1 TO 3 WEEKS POST GA 11.5(+/-4.2)	FOLLOWING TREATMENT UNDER GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS (P<=0.001)
2014	THOMSON et al.[26]	268 FINAL PARTICIPANTS 51.3%BOYS (WELLINGTON) & 56.7%BOYS(AUCKLAND) AGE 4.8Y (AUCKLAND) & 5.5Y (WELLINGTON)	GREENLANE CLINICAL CENTRE SHORT STAY SURGICAL UNIT AUCKLAND&WELLINGTON,NEW ZEALAND KENEPURU HOSPITALS WELLINGTON, NEW ZEALAND	DAY OF GA 11.5	1 WEEK TO 1 MONTH POST GA 4.4	FOLLOWING GA, THERE WAS STATISTICALLY SIGNIFICANT DECREASE IN ECOHIS

2015	YAWARY et al.[24]	70 INITIAL PARTICIPANTS UNDER AGE 6/57.6% BOYS/MEAN AGE 4.1Y 39 PARTICIPANTS (55.7% FOLLOW-UP RATE)	UNIVERISTY OF WESTERN AUSTRALIA, PERTH, AUSTRALIA	DAY OF TREATMENT ECOHIS MEAN 27.85	2 WEEK POST TREATMENT / ECOHIS MEAN 19.26 3 MONTH POST TREATMENT/ ECOHIS MEAN 17.15	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS (P<=0.001)
2016	Li et al.[21]	62 FINAL PARTICIPANTS 45%BOYS AGE 5.4Y	FIRST AFFILIATED HOSPITAL OF ZHENGZHOU UNIVERSITY HENAN, CHINA	BEFORE GA 13.1 (+/- 17.2)	1 MONTH POST GA 1.9 (+/-3.2)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS (P<=0.001)
2017	COLLADO et al.[16]	25 PARTICIPANTS AT 1 MONTH POST OP / 17 PARTICIPANTS AT 3 MONTH POST OP 44%BOYS AGE 57.9 MONTHS(+/-10.5)	UNIVERISTY HOSPITAL, CLERMONT-FERRAND, FRANCE	DAY OF GA 11.04(+/-7.67)	1 MONTH POST GA 1.71(+/-1.52) 3 MONTH POST GA 1.08(+/-1.63)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS (P<=0.01)
2017 (2014)	JANKAUSKIENE et al.[19]	122 PARTICIPANTS AT 1 MONTH POST OP / 118 PARTICIPANTS AT 6 MONTH POST OP 54.9% BOYS AGE 3.9Y(+/-0.8Y)	LITHUANIAN UNIVERISTY OF HEALTH SCIENCES HOSPITAL, KAUNAS, LITHUANIA	21.7 (MALE) 18.9 (FEMALE)	1 MONTH POST GA 6.5 (+/-4.8)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS AT 1 MONTH POST-OP (P<0.001) AND REMAINED LOW AT THE 6 MONTH RECALL.
2017	Nan et al.[25]	55 PARTICIPANTS AT 1 MONTH POST OP 60% BOYS 3 YEAR OLDS 58% 4 YEAR OLDS 33% 5 YEAR OLDS 9%	HOSPITAL OF STOMATOLOGY, JILIN, CHINA	BEFORE GA 21.36(+/-4.96)	1 MONTH POST GA 10.56 (+/-2.39)	FOLLOWING GA, THE TOTAL ECOHIS SCORES DECREASED BY 51% (P<0.001)
2017	RANE et al.[23]	25 PARTICIPANTS UNDER AGE 6	NERUL, MAHARASHTRA, INDIA	PRIOR TO GA NO ECOHIS TOTAL MEAN CALCULATED	1 MONTH POST GA NO ECOHIS TOTAL MEAN CALCULATED	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS FOR MOST QUESTIONS (P<0.001)
2018	FARSI et al.[17]	131 INITIAL PARTICIPANTS AGE 6 AND UNDER 114 PARTICIPANTS AT 1 MONTH FOLLOW-UP 42.1%BOYS AGE 4.4(+/-1.2Y)	KING ABDULAZZA UNIVERSITY HOSPITAL NATIONAL GUARD HOSPITAL KING FAHD HOSITAL JEDDAH, SAUDIA ARABIA	PRIOR TO GA 19.9 (SD 10.3)	1 MONTH POST GA 4.3 (SD 4.8)	FOLLOWING GA, THERE WAS SIGNIFICANT DECREASE IN ECOHIS AT 1 MONTH POST-OP (P=0.043)

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