



# Early Childhood Caries and Quality of Life: Child and Parent Perspectives

Sara L. Filstrup, DDS, MS Dan Briskie, DDS Marcio da Fonseca, DDS, MS  
Leslie Lawrence, DMD, MS Angela Wandera, BDS, MS Marita Rohr Inglehart, PhD

*Dr. Filstrup was a student, School of Dentistry, University of Michigan, Ann Arbor, Mich, and is currently in private practice, Worcester, Mass; Dr. Briskie is director, Department of Pediatric Dentistry, Mott Children's Health Center (MCHC), Flint, Mich;*

*Dr. da Fonseca is associate clinical professor, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, University of Michigan, Ann Arbor, Mich; Dr. Lawrence is staff dentist, Department of Pediatric Dentistry, MCHC, Flint, Mich;*

*Dr. Wandera was assistant clinical professor, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, University of Michigan and currently is in private practice, Minneapolis/St. Paul, Minn; Dr. Inglehart is associate professor, School of Dentistry and adjunct associate professor, Department of Psychology, University of Michigan, Ann Arbor, Mich.*

*Correspond with Dr. Filstrup at sarafio@msn.com*

## Abstract

**Purpose:** The purpose of this study was to investigate the effects of early childhood caries (ECC) on children's oral health-related quality of life (QOL) before and 4 weeks after its treatment, as assessed by the children themselves as well as by their parents/guardians.

**Methods:** This study had a longitudinal intervention design. Sixty-nine children diagnosed with ECC and 43 children without caries (combined children's mean age=50.4 months; range=22 to 70 months) and their parents/guardians responded to face-to-face administered surveys before a dental treatment was started (baseline assessment). Thirty-seven children with ECC completed dental rehabilitation. Four weeks after the treatment was completed, these 37 children as well as their parents/guardians responded to a second survey (follow-up assessment).

**Results:** The results show that children with ECC have significantly lower oral health-related QOL than children without ECC as assessed both by the children and the parents/guardians at baseline. The children with ECC who received dental treatment had a significantly improved oral health-related QOL at the follow-up assessment when compared with their baseline measurement as measured both with the children's self-ratings of oral health-related QOL and the parents'/guardians' perception of their child's oral health-related QOL.

**Conclusions:** ECC and its treatment affect children's oral health-related QOL in a significant way. Oral health-related QOL can be assessed validly and reliably both in self-reports from children as young as 36 months of age as well as by asking parents/guardians about their perceptions of their child's oral health-related QOL. (*Pediatr Dent*. 2003;25:431-440)

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Despite the United States' high-ranking affluence, the abundance of State and Federal funding, widespread community fluoridation of water and the perceived improvements in general and oral health awareness, dental caries continues to plague children, unabated. Dental caries is the single most common chronic childhood disease; it is 5 times more common than asthma, 7 times more common than hay fever, and 14 times more common than chronic bronchitis.<sup>1,2</sup> According to statistics from

the years 1988 to 1994, dental caries affects 18% of young children aged 2 to 4 years, 52% of children aged 6 to 8 years, and 61% of adolescents by the age of 15 years in the United States.<sup>3</sup> The percentage of untreated dental decay is 16% in young children aged 2 to 4 years, 29% in children aged 6 to 8 years, and 20% in adolescents by the age of 15 years in the United States.<sup>3</sup>

In the year 2000, the first US Surgeon General's report on oral health revealed profound oral health disparities in

the US population related to socioeconomic status, age, sex, race/ethnicity, and medical status.<sup>1</sup> Children at high risk of dental disease are those from low-income and/or underrepresented minority families, and children with special health care needs.<sup>4</sup>

Early childhood caries (ECC) is a relatively new term that encompasses all dental caries occurring in the primary dentition of young children from birth to 71 months of age.<sup>5,6</sup> Over the past 40 years, this pattern of disease has been referred to as labial caries, caries of incisors, rampant caries, nursing bottle caries, and baby bottle tooth decay.<sup>7</sup> ECC is defined as the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled surfaces in any primary tooth. The term severe early childhood caries (S-ECC) is used to refer to “atypical,” “progressive,” “acute,” or “rampant” patterns of decay. The diagnosis of ECC or S-ECC is dependent on the age of the child and extent of caries experience (decayed, missing, and filled tooth surfaces).<sup>6</sup>

In 1976, Davis argued that oral disease has only minimal relevance for a person's life.<sup>8</sup> This notion has been clearly challenged by recent research demonstrating the consequences of dental disease in children (see the overview by Inglehart, Filstrup, and Wandera).<sup>9</sup> The consequences of ECC include a higher risk of new carious lesions,<sup>10-13</sup> hospitalizations and emergency room visits,<sup>14-17</sup> increased treatment cost and time,<sup>18,19</sup> delayed or insufficient physical development (especially in the child's height and/or weight),<sup>20,21</sup> loss of school days and increased days with restricted activity,<sup>22-24</sup> and a diminished ability to learn.<sup>25-28</sup>

More recently, research started to demonstrate the impact of severe dental caries and its rehabilitation on a child's quality of life (QOL).<sup>29-31</sup> In 1999, Low et al showed the effect of severe caries on the QOL in young children as assessed by the child's parent/guardian.<sup>29</sup> In 2001, Acs et al studied the perceived outcomes and parental satisfaction following dental rehabilitation of children with caries under general anesthesia.<sup>30</sup> Both studies showed that parents perceived an improvement in their child's QOL following comprehensive dental rehabilitation under general anesthesia. These improvements pertained to the child having less pain and improved abilities to eat and sleep. In 2002, Thomas and Primosch showed that, while the rehabilitation of ECC led only to a slight nonsignificant increase in the mean percentile of the children's weight, it led to a significant improvement of the children's QOL as reported by their parents.<sup>31</sup>

Three considerations are the basis for this follow-up study on these 3 earlier studies. First, it seems important to explore whether children themselves perceive their own QOL as impaired by ECC and whether they themselves are able to communicate their own oral health-related QOL reliably and validly to adults. This study was, therefore, designed to assess both the child's self-reported oral health-related QOL as well as the parent's/guardian's perception of their child's oral health-related QOL. Second, immedi-

ately following dental rehabilitation, a child and parent/guardian may be tuned into the fact that the child's disease was treated and thus evaluate the child's oral health-related QOL in an optimistic manner despite the fact that a clear improvement may only follow consequently over a period of time. To assess the child's actual oral health-related QOL after dental rehabilitation, this study measured the child's self-reported oral health-related QOL and the parent's/guardian's proxy assessment of the child's oral health-related QOL 4 weeks after the dental rehabilitation when the child had returned to life's routines. Third, careful methodological considerations were given as to how oral health-related QOL should be measured. Following the lead of studies on adults' oral health-related QOL, this study used multidimensional scales to assess oral health-related QOL.<sup>32</sup> These scales, the Michigan Oral Health-related QOL Scales—Version C (child) and Version PG (parent/guardian), assess children's oral health-related QOL by including not only items concerning functional aspects and pain/discomfort, but also psychological aspects such as “Do you like your teeth?” and social aspects such as “Do kids make fun of your teeth?”

The inclusion of psychological and social aspects of oral health-related QOL goes beyond including the functional and pain aspects of oral health-related QOL that were addressed in earlier studies.<sup>29-31</sup> Additional thought was given to the answer format of the parent/guardian scale. The parent/guardian scale gives the parents/guardians an opportunity to respond on 5-point answering scales. These graded responses capture the parents'/guardians' responses in a differentiated manner and allow the use of higher-level statistical analyses.

In summary, the objectives of this study were to assess the effects of ECC on oral health-related QOL as reported by the children themselves as well as by their parents/guardians, to explore how the treatment of ECC affects the child patient's oral health-related QOL after they return to their “normal” life, and to develop multidimensional and differentiated scales for measuring children's self-reported oral health-related QOL as well as their parent's/guardian's proxy reports of their child's oral health-related QOL.

## Methods

### Survey design

This study was an intervention study that addresses how ECC and the treatment of ECC affect children's oral health-related QOL and parents'/guardians' perceptions of their child's oral health-related QOL. The research was conducted at the Pediatric Dental Clinic at Mott Children's Health Center (MC) in Flint, Mich, and at the Children's Clinic at the University of Michigan School of Dentistry (UM) in Ann Arbor, Mich. Both the Mott Children's Health Center Institutional Review Board and the University of Michigan Health Sciences Institutional Review Board approved the research. Children diagnosed with

## Child Version

How much do you disagree/agree with the following statements:

1. My child has difficulty chewing.
2. My child has difficulty biting hard.
3. My child's teeth are sensitive to hot or cold.
4. My child's teeth are sensitive to sweet food.
5. My child has a toothache or pain now.
6. My child's toothache keeps my child from sleeping through the night.
7. My child's toothache keeps my child from playing.
8. My child's toothache keeps my child from learning at school.
9. My child is happy with his/her teeth.
10. My child complains about his/her teeth.

Figure 1. Michigan Oral Health-related Quality of Life Scale–Child Version. Responses were either “yes” or “no.”

## Parent/Guardian Version

Screening Questions 1 and 2 for children under 72 months of age:

S1. Are you a boy or a girl?

If correct answer to S1, continue with S2:

S2. What does a dentist clean and fix?

If correct answer to S2, continue with MOHRQOL Scale questions:

1. Do your teeth hurt you now?
2. Do your teeth hurt when you eat something hot or cold?
3. Do your teeth hurt when you eat something sweet?
4. Does a hurting tooth wake you up at night?
5. Does a hurting tooth stop you from playing?
6. Is it hard for you to chew and bite?
7. Do you like your teeth?
8. Are you happy with your teeth and smile?
9. Do kids make fun of your teeth?

Figure 2. Michigan Oral Health-related Quality of Life Scale–Parent/Guardian Version. Responses were given on a 5-point rating scale ranging from 1=“strongly disagree” to 5=“strongly agree.”

ECC (experimental group) and children without caries (control group) and their parents/guardians participated in face-to-face interviews before the dental treatment was started (baseline assessment). Children with ECC then participated in full-mouth dental rehabilitation (intervention) either in 1 appointment under general anesthesia or in several appointments under local anesthesia with or without oral conscious sedation. Four weeks after the completion of the treatment, children with ECC and their parents/guardians returned for a follow-up face-to-face interview (follow-up assessment).

### Respondents

One hundred twelve child and parent/guardian pairs were recruited at the Pediatric Dental Clinic at MC in Flint, Mich between January 5, 2001 and July 13, 2001, and at the Children's Clinic at UM in Ann Arbor, Mich between June 28, 2001 and October 3, 2001. All children were healthy (ASA 1) and there were no language barriers for the children or their parents/guardians. The children ranged in age from 22 months to 70 months (mean age=50.4 months). The respondents can be categorized into 3 groups. Group I consisted of 37 children diagnosed with ECC and their parents/guardians who participated both in the baseline and the follow-up surveys. Group II consisted

of 32 children diagnosed with ECC and their parents/guardians who only completed the baseline surveys. Group III was the control group. It was comprised of 43 caries-free children in the same age range as the children in the ECC groups I and II.

To analyze whether children with ECC differ in their oral health-related QOL from children without ECC and whether the parents'/guardians' evaluations of their child's oral health-related QOL differ for these 2 groups, the baseline data of the children and of the parents/guardians in Groups I and II were combined and compared with the data of the respondents in Group III. Before the data of Groups I and II were combined, statistical tests were conducted to explore whether the responses of the children as well as the parents/guardians in the 2 ECC groups differed significantly in their oral health-related QOL at baseline. A *t* test for independent samples showed that the sum of the children's responses to the child scale in Groups I and II did not differ significantly ( $t=-0.971$ ;  $df=30$ ;  $P=.339$ ; Figure 1). Additionally, chi-square tests were conducted for the responses to each single item to analyze whether the children in the 2 ECC groups differed in their responses to any of these items at baseline. Not one of the chi-square tests was significant. Given these results, the responses of

the children in Groups I and II were combined when analyzing the relationship between ECC and oral health-related QOL at baseline. To compare the parents'/guardians' responses in Groups I and II, a MANOVA was conducted with the independent variable ECC and the 2 levels "ECC: baseline and follow-up" vs "ECC: baseline only" and the 10 dependent variables from the parent/guardian scale (Figure 2). The main effect was not significant ( $F(10/27)=0.871$ ;  $P=.570$ ), and none of the 10 univariate tests were significant. Given these results, the parents'/guardians' responses in Groups I and II were therefore combined when analyzing the baseline data.

### Inclusion criteria

The inclusion criteria were developed using the definition of the 1999 ECC Workshop as a guide.<sup>7</sup> The interpretation and modification of the definition include the use of the adjusted decayed, missing, and filled surface (dmfs) scores per age group (rather than the distinction of smooth surface decay and fissure decay) and the requirement of 1 tooth with pulpal involvement. The inclusion criteria are the following: dmfs scores greater than the child's age in years and at least 1 tooth with pulpal involvement.

### Procedures

At each location, the participating staff screened the regularly scheduled child patients for ECC. If the child fulfilled the criteria, the principal investigator would inform the parent/guardian about the current study and obtain formal consent for participation. All child and parent/guardian baseline and follow-up surveys were conducted in face-to-face interviews. This face-to-face format was chosen because of the young age of the children and the high rate of illiteracy of the parents/guardians that receive care at MC. A \$10 gift certificate to a local toy store was given to each child at the completion of the 1-month follow-up survey. If a child and parent/guardian pair missed the follow-up examination, reminder phone calls were made and/or reminder flyers were sent in the mail. Of the 69 ECC respondents who participated in the study, 37 (54%) completed both the baseline and follow-up surveys, while 32 (46%) completed only the baseline survey. Of the 32 respondents who completed the baseline survey only, 25 (78%) did not complete treatment as of October 19, 2001, and 7 (22%) completed the treatment but did not return for the 1-month follow-up survey.

### Measures

**Michigan Oral Health-related Quality of Life Scale-Child Version:** The children's oral health-related QOL was measured with the Michigan Oral Health-related Quality of Life Scale-Child Version. This scale was originally developed as a multidimensional measure of oral health-related QOL in children 4 years of age and older. The original scale consisted of 7 items and covered 3 dimensions, namely pain/discomfort ("Do your teeth hurt

you now?" "Did your teeth hurt you in the last days?" "Do your teeth hurt when you eat something hot or cold?"), functioning ("Is it difficult for you to chew?" "Is it difficult for you to bite?"), and psychological aspects ("Are you happy with your teeth?" "Do you have a nice smile?"). Results of a study with 203 Hispanic migrant worker children in northern Michigan (83 girls/120 boys; age range=4 to 16 years of age; mean age=8.18 years) showed that 183 children could answer these questions.<sup>33</sup> The reliability of this earlier scale was 0.54. The items have face validity.

For the purpose of this study on ECC, this original scale was changed in 2 ways. First, it had to be adapted for use with younger children. To be able to evaluate if a child was able to answer the questions, 2 screening questions were included. These 2 screening questions were:

1. whether a child knew his or her gender ("Are you a boy or a girl?"); and
2. whether the child knew what a dentist does ("What does a dentist clean and fix?").

If the child was able to answer both screening questions meaningfully, the scale was administered.

Second, in order to assess the social aspect of oral health-related QOL, 2 additional questions ("Does a hurting tooth stop you from playing?" "Do kids make fun of your teeth?") were added. Given the specific concerns of patients with ECC, a question concerning sleeping through the night ("Does a hurting tooth wake you up at night?") was added as well.

### Michigan Oral Health-related Quality of Life Scale-Parent/Guardian Version:

The development of a parent/guardian proxy measure of a child's oral health-related QOL was based on 3 considerations. First, the child and the parent/guardian should consider equivalent aspects of the child's life when evaluating the child's oral health-related QOL. The content of the parent/guardian questions was therefore matched with the content of the child's self-reported questions.

Second, given the cognitive background of adults, the parent/guardian should have a way to respond in a more differentiated manner than the child. Five-point answering scales (ranging from 1="disagree strongly" to 5="agree strongly") were therefore used instead of the "yes/no" response format that was used for the child version. This interval scale format allows the use of more sophisticated methods of analyses such as factor analyses and multivariate analyses of variance (MANOVA) when analyzing the responses.

Third, considering the fact that ECC is most rampant in socioeconomically deprived populations with lower levels of education, a major effort was made to develop a scale that required a low level of reading comprehension.<sup>1</sup> A first version of a scale that fulfilled these 3 requirements was developed and piloted with 50 parents/guardians in an inner city dental practice in Grand Rapids, Mich. The results of this first study showed that these parents/guardians



were able to understand and answer these questions by using this type of answering scale.

### Statistical analyses

Statistical analyses were performed using the SPSS Base 10.0 statistical software program. The children's responses to the QOL questions were categorical (yes/no responses) and single-item analyses were conducted using nonparametric tests (such as the McNemar Test and chi-square test). The parents'/guardians' responses were given on five-point rating scales and were analyzed using MANOVAS.

## Results

### Overview of respondents

The 112 respondents were nearly evenly divided among the 3 groups (Table 1). The combined groups' mean age was 50.4 months (4.2 years) and ranged from 22 months to 70 months. Eighty-seven percent of the respondents were recruited from MC while 13% were recruited from UM. The majority of adult participants were the children's parents (94%), while only 6% were grandparents and even fewer were foster parents (1%). The children with ECC not only met, but also exceeded the study inclusion criteria with a combined mean of 25.9 dmfs surfaces, 9.3 dmfs teeth, and 3.5 teeth with pulpal involvement per child. Of the 37 children who completed full-mouth dental rehabilitation, 62% (N=23) were treated under local anesthesia with conscious sedation, 19% (N=7) were treated under local anesthesia only, and 19% (N=7) were treated under general anesthesia in the operating room.

### Children's participation in the baseline surveys

The earliest age in which a child participated in the baseline survey was 36 months of age (Table 2). Sixty-five percent of 3-year-old children participated in the child survey (part 1 only=22%; parts 1 and 2=43%), while 35% of 3-year-olds did not participate in any portion of the survey. The participation percentages continued to improve with the 4-year-old and 5-year-old children, respectively.

### Baseline assessment—oral health-related QOL before the dental treatment

**Child:** It was expected that children with ECC would have significantly lower self-reported oral health-related QOL than children without caries. The responses to the questions "Do you like your teeth?" and "Are you happy with your teeth and smile?" were reversed to achieve unidirectional scales. The "no" response to these 2 questions indicates negative quality of life, while the "yes" response indicates negative quality of life for the other 7 questions. Due to the categorical nature of the children's responses to the 9 questions, the individual scores were compared using chi-square tests for comparison of 2 unrelated samples. The number "1" was used to represent a child's

**Table 1. Overview of the Child Respondents in 3 Groups**

	<b>Group I* ECC baseline + follow-up</b>	<b>Group II* ECC baseline only</b>	<b>Group III* Caries-free control</b>
Number (N)	37	32	43
Mean age (range)	52.3 mo (22-70 mo)	52.8 mo (28-70 mo)	47.2 mo (34-66 mo)
Gender	Male-51% Female-49%	Male-41% Female-59%	Male-37% Female-63%
Location of recruitment†	MC-81% UM-19%	MC-91% UM-9%	MC-88% UM-12%
Parent/guardian relationship	Parent-97% Foster parent-3%	Parent-97% Grandparent-3%	Parent-88% Grandparent-12%
Oral health status indicators-mean (range)	dmfs 28.7 (6-66) dmft 10.0 (3-20) Pulpal involvement 3.8 (1-11)	dmfs 23.0 (5-44) dmft 8.5 (2-14) Pulpal involvement 3.2 (1-7)	dmfs 0 dmft 0 Pulpal involvement 0

\*Percentages of responses are determined by using the total number of respondents in a given group. MC=Mott Children's Health Center; UM=University of Michigan School of Dentistry.

**Table 2. Children's Participation in the Baseline Surveys**

	<b>Parts 1 and 2 answered</b>	<b>Only part 1 answered</b>	<b>No questions answered</b>
All children (N=112)	55% (N=61)	15% (N=17)	30% (N=34)
Mean child age (range)	54.1 mo (36-70 mo)	48.7 mo (36-63 mo)	44.0 mo (22-70 mo)
1 y* (12-23 mo)	N=0	N=0	N=1 (100%)
2 y* (24-35 mo)	N=0	N=0	N=9 (100%)
3 y* (36-47 mo)	N=16 (43%)	N=8 (22%)	N=13 (35%)
4 y* (48-59 mo)	N=28 (68%)	N=6 (15%)	N=7 (17%)
5 y* (60-71 mo)	N=17 (71%)	N=3 (12%)	N=4 (17%)

\*Percentages in age demarcations are determined by using the total number of children in each age bracket across the horizontal.

response indicating negative QOL, while the number "0" was used to represent a child's response indicating positive quality of life. As can be seen in Table 3, the children with ECC have significantly higher percentages of agreement with all 9 oral health-related QOL questions that indicate negative QOL than the children in the caries-free control group at baseline.

**Table 3. Children's Percentages of Agreement With Items That Indicate Negative Oral Health-related QOL in the ECC Groups and the Control Group at Baseline**

Questions	Groups I + II ECC (N=69)	Group III Caries-free (N=43)	P value
Do your teeth hurt you now?	62%	3%	<.001
Do your teeth hurt when you eat something hot or cold?	68%	12%	<.001
Do your teeth hurt when you eat something sweet?	74%	8%	<.001
Does a hurting tooth wake you up at night?	53%	0%	<.001
Does a hurting tooth stop you from playing?	47%	0%	<.001
Is it hard for you to chew and bite?	73%	0%	<.001
Do you like your teeth? (reversed-"no")*	35%	0%	<.001
Are you happy with your teeth and smile? (reversed-"no")*	32%	0%	<.001
Do kids make fun of your teeth?	36%	4%	<.001

\*The responses to the questions "Do you like your teeth?" and "Are you happy with your teeth and smile?" were reversed to achieve unidirectional scores.

**Table 4. Parents'/Guardians' Average Evaluations of Children's Oral Health-related QOL in the ECC Groups and the Control Group at Baseline**

Questions*	Groups I + II ECC (N=69)	Group III caries-free (N=43)	P value
My child has difficulty chewing.	2.47	1.13	<.001
My child has difficulty biting.	2.87	1.08	<.001
My child's teeth are sensitive to hot or cold.	2.61	1.21	<.001
My child's teeth are sensitive to sweet food.	2.63	1.21	<.001
My child has a toothache or pain now.	3.37	1.10	<.001
My child's toothache keeps my child awake at night.	2.29	1.00	<.001
My child's toothache keeps my child from playing.	1.92	1.00	<.001
My child's toothache keeps my child from learning at school.	1.90	1.00	<.001
My child is happy with his/her teeth. (reversed)†	3.39	1.18	<.001
My child complains about his/her teeth.	3.50	1.13	<.001
Interference index (toothache, awake, no play, no learn, and complain).‡	2.60	1.05	<.001
Function index (chew, bite, hot/cold, sweet, and happy).‡	2.80	1.16	<.001

\*The responses were given on a 5-point rating scale ranging from 1="disagree strongly" to 5="agree strongly."

†The responses to the question "My child is happy with his/her teeth" were reversed to achieve unidirectional scores.

‡Indices were created by averaging the parent's/guardian's answers to the 5 items included in each index.

**Parent/guardian:** It was also expected that the parents/guardians of children with ECC would perceive their child's oral health-related QOL as worse than the parents/guardians of children without ECC. The parents'/guardians' responses were given on a 5-point rating scale ranging from 1="disagree strongly" to 5="agree strongly." The responses to the statement "My child is happy with his/her teeth" were reversed to achieve unidirectional scores. A score of 1 indicated a positive quality of life, while a score

of 5 indicated the most negative quality of life. A MANOVA with the independent variable "ECC status" (ECC vs no ECC) and the answers to the 10 oral health-related QOL items as dependent variables showed that the 2 groups of children differed significantly in their oral health-related QOL, as measured by their parents'/guardians' responses ( $F(10/66) = 11.291$ ;  $P < .001$ ). As can be seen in Table 4, the univariate analyses were also significant, indicating that the 2 groups differed significantly in their responses to each of the 10 items.

Given the multidimensional nature of the scale, indices of the parents'/guardians' perceptions of their child's oral health-related QOL were constructed. To construct these indices, a factor analysis of the 10 items was conducted (Extraction Method: Principal Component Analysis; Varimax Rotation Method). The items loaded on 2 factors. The items "My child has a toothache or pain now," "My child's toothache keeps my child awake at night," "My child's toothache keeps my child from playing," "My child's toothache keeps child from learning at school," and "My child

complains about his/her teeth" loaded on factor 1. This factor was interpreted as the parent's/guardian's perception of how much their child's oral health status interferes with their child's life. An "interference" index was accordingly created by averaging the parents'/guardians' answers to these 5 items. The reliability of this index was Cronbach's alpha=0.88. Cronbach's alpha is a measure of reliability that assesses whether a survey measures accurately.<sup>34</sup> The items "My child has difficulty chewing," "My child has difficulty biting hard,"

“My child’s teeth are sensitive to hot or cold,” “My child’s teeth are sensitive to sweet food,” and “My child is happy with his/her teeth (reversed)” loaded on factor 2. This factor was interpreted as parents’/guardians’ perceptions of how their child’s oral functioning affects their child’s life. The “function” index was created by averaging the parents’/guardians’ answers to these 5 items. The reliability of this index was Cronbach’s alpha=0.83.

A MANOVA was performed to test whether the “interference” and “function” indices of the parents/guardians in the ECC groups differ significantly from the parents’/guardians’ indices in the control group. The main effect of this MANOVA is significant ( $F(2/74)=33.696$ ;  $P<.001$ ) and the means of the indices for the 2 groups are in the predicted direction (Table 4).

#### Treatment outcomes—baseline assessment vs follow-up assessment

**Child:** It was expected that the treatment of ECC and the elimination of oral disease would improve a child patient’s self-reported oral health-related QOL. To test this hypothesis, a repeated measurement analysis (McNemar test) was conducted with the baseline and follow-up oral health-related QOL responses of the children with ECC who completed both the baseline and the 4-week follow-up surveys ( $N=37$ ). As can be seen in Table 5, 8 of the 9 items had differences in the predicted direction between the average responses at baseline and follow-up points in time, and 4 of these differences were significant.

**Parent/guardian:** It was also expected that the parents’/guardians’ evaluations of their child’s oral health-related QOL in the ECC group would improve after the treatment of ECC. Two-repeated measurement MANOVAs were used to test this hypothesis. The first MANOVA included the 10 individual items as dependent variables, and the second MANOVA included the 2 indices as dependent variables. The main effects of both MANOVAs were significant (MANOVA with 10 single items:  $F(10/17)=6.06$ ,

**Table 5. Children’s Percentages of Agreement With Items That Indicate Negative Oral Health-related QOL at Baseline and 4 Weeks After Dental Treatment**

Questions	Baseline	Follow-up	P value
Do your teeth hurt you now?	38%	3%	.001
Do your teeth hurt when you eat something hot or cold?	27%	0%	.008
Do your teeth hurt when you eat something sweet?	35%	3%	.002
Does a hurting tooth wake you up at night?	16%	0%	.063
Does a hurting tooth stop you from playing?	16%	3%	.125
Is it hard for you to chew and bite?	32%	3%	.001
Do you like your teeth? (reversed–“no”)*	73%	49%	.125
Are you happy with your teeth and smile? (reversed–“no”)*	68%	46%	.250
Do kids make fun of your teeth?	8%	8%	1

\*The responses to the questions “Do you like your teeth?” and “Are you happy with your teeth and smile?” were reversed to achieve unidirectional scores.

**Table 6. Parents’/Guardians’ Average Evaluations of Children’s Oral Health-related QOL at Baseline and 4 Weeks After Dental Treatment**

Questions*	Baseline mean	Follow-up mean	P value
My child has difficulty chewing.	2.62	1.19	<.001
My child has difficulty biting hard.	2.71	1.14	<.001
My child’s teeth are sensitive to hot or cold.	2.76	1.29	.002
My child’s teeth are sensitive to sweet food.	2.33	1.14	.004
My child has a toothache or pain now.	3.43	1.24	<.001
My child’s toothache keeps my child awake at night.	2.52	1.00	<.001
My child’s toothache keeps my child from playing.	1.86	1.10	.029
My child’s toothache keeps my child from learning at school.	1.86	1.29	.156
My child is happy with his/her teeth. (reversed)†	3.52	1.38	<.001
My child complains about his/her teeth.	3.48	1.57	<.001
Interference index (toothache, awake, no play, no learn, and complain).‡	2.63	1.24	<.001
Function index (chew, bite, hot/cold, sweet, and happy).‡	3.01	1.22	<.001

\*The responses were given on a 5-point rating scale ranging from 1=“disagree strongly” to 5=“agree strongly”.

†The responses to the question “My child is happy with his/her teeth” were reversed to achieve unidirectional scores.

‡Indices were created by averaging the parent’s/guardian’s answers to the five items included in each index.

$P=.002$ ; MANOVA with 2 indices:  $F(2/25)=18.49$ ,  $P<.001$ ). As can be seen in Table 6, 9 of the 10 univariate analyses of variance for the single items had significant main effects, and the univariate analyses for both indices show a significant main effect of time. The baseline and follow-

up single item responses as well as the perceived “interference” and “function” indices clearly showed that the parents/guardians perceived an improvement in their child’s oral health-related QOL after the treatment was completed.

## Discussion

### Young children’s self-reported oral health-related QOL

Earlier research on the relationship between ECC and oral health-related QOL had shown that parents can perceive an improvement of their child’s well-being after dental treatment.<sup>29-31</sup> The results of this study additionally showed that children themselves, even as young as 3 years of age, can communicate their oral health-related QOL validly. Children with ECC reported significantly lower oral health-related QOL than children who were caries free. Additionally, children who received dental treatment for ECC reported a significantly improved oral health-related QOL 4 weeks after the treatment as compared to their responses before the treatment.

These results show that some children as young as 36 months of age are able to answer questions about their own oral health in a valid fashion. The results should encourage providers to re-evaluate their communication patterns with children in this age group. Prior research had suggested that only children 4 and 5 years of age or older can participate in questionnaire studies and provide information about their pain experiences.<sup>35-39</sup> However, this study shows that some younger children are also able to communicate their oral health and oral health-related QOL in a valid manner. These results show that a child’s developmental age rather than a child’s chronological age should be the deciding factor when considering what kind of information to elicit from a young child.

Although the responses to all questions are significantly different for the ECC children vs the children in the control group, it is curious to find that there are children with extensive decay that do not report a diminished oral health-related QOL on some of the items (Table 3). This could be due to the fact that these data were collected at one very specific point in a child’s life. The acute stage in caries is cyclic in nature. Although a tooth may have been hurting 1 week earlier, that same tooth may have become necrotic or created a fistula through the bone relieving the pressure and pain currently. In a child with ECC, this process moves from tooth to tooth, thus making it possible for a child with ECC to have pain in a different quadrant of their mouth each week. Additionally, when these children live with chronic pain, they may describe a tooth that is only slightly uncomfortable as not painful. From the child’s perspective, a tooth that only hurts when he/she eats is not as bad as a tooth that spontaneously hurts throughout the day and/or night.

In summary, this study shows that children’s reports of their own oral health-related QOL are an important

diagnostic tool when assessing children’s needs for dental care. These results provide support for child advocates who argue that only children themselves can provide a subjective perspective of their health and their feelings about their health.<sup>36,40-42</sup> Given these findings, it is important to provide education about oral health-related QOL issues plus an instrument to measure oral health-related QOL in young child patients to caregivers such as childcare personnel, Head Start teachers, social workers, and general health care providers. These professionals and allies can contribute by diagnosing the need for dental care in young children and helping these children get the dental care they need.

### Parents’/guardians’ evaluations of their children’s oral health-related QOL—proxy reports

The results showed that parents/guardians of children with ECC evaluated their child’s oral health-related QOL as worse than parents/guardians of children without ECC, and that they were able to realize that dental treatment of ECC improved a child’s oral health-related QOL. These results provided evidence that the Parent/Guardian Scale has construct validity.

Although the parents/guardians in the ECC vs the control groups differed significantly on all single-item responses (Table 4), it is interesting that the parents’ average responses in the ECC groups range merely from 1.90 to 3.50 on the 5-point rating scales. This result may be due to the fact that the children were not experiencing a diminished oral health-related QOL at all times. Given this fact, the parents did not perceive that their child had a diminished oral health-related QOL at all or at given times. Focusing on the latter possibility, it is interesting to note that the 3 questions that showed the strongest effects were the questions “My child complains about his/her teeth” (3.50), “My child is happy with his/her teeth (reversed)” (3.39), and “My child has a toothache or pain now” (3.37). These items might be the ones that get the highest degree of the parents’/guardians’ attention. They might also indicate that, until the decay interferes with the child’s life, the parent/guardian may be unaware that a dental problem exists.

In summary, the parent/guardian scale is a reliable and valid measurement instrument that could be of great use as a communication tool to alert parents/guardians to their child’s need for dental care. Children in this age group are not in the position to refer themselves for treatment, even when they are experiencing powerful symptoms and pain. Ultimately, it may be the parents’/guardians’ perceptions of their child’s oral health-related QOL that may decide whether care will be sought for children.<sup>36,43-45</sup> Additionally, the use of a proxy rater is also necessary when the patient is either unable or unwilling to complete the oral health-related QOL measure.<sup>43</sup> Furthermore, when differences emerge in parent vs child reports about a child’s oral health-related QOL, dental healthcare providers could share and discuss these discrepancies with the parents/guardians and children as a way to facilitate and improve



communication between the parent/guardian and the child.<sup>9,41</sup>

Ultimately, this research is working toward the US Surgeon General's goal to:

1. ensure that oral health is seen as integral to the general health and the QOL of children;
2. engage the child health and welfare community and the public in a discussion of these issues in children's health; and
3. promote effective partnerships and community collaborations to eliminate disparities in children's oral health and access to care.<sup>1,4</sup>

### Study limitations

A possible limitation of this study is the small sample size (N=37) of the children with ECC who completed both the baseline and follow-up surveys. It is interesting to compare the families that completed both baseline and follow-up surveys with those who completed only baseline surveys and did not return to finish the dental treatment or to respond to the 4-week follow-up survey. The data suggest that those parents/guardians who did not complete their child's treatment or return for the follow-up survey after the treatment had greater stress in their lives than the parents who completed the treatment and follow-up survey as indicated by their efforts of "seeking a job" (28% vs 11%) and having an income less than \$10,000 (38% vs 30%). Family demographic differences, such as these, are to be further investigated.

### Conclusions

1. Some children as young as 36 months of age are able to answer questions about their own oral health and oral health-related QOL, and as children age they are increasingly more able to report their oral health-related QOL reliably and validly.
2. Children's self-reported oral health-related QOL is significantly correlated with their oral health. Children with ECC had significantly worse oral health-related QOL than caries-free children. Children with ECC had a significantly improved oral health-related QOL after treatment.
3. Parents'/guardians' evaluations of their child's oral health-related QOL are significantly related to their child's oral health.

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