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Caregivers' oral health literacy and their young children's oral health-related quality of life

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Abstract

Objectives—To investigate the association of caregivers' oral health literacy (OHL) with their children's oral health related-quality of life (C-OHRQoL) and explore literacy as a modifier in the association between children's oral health status (COHS) and C-OHRQoL.

Methods—We relied upon data from structured interviews with 203 caregivers of children ages 3-5 from the Carolina Oral Health Literacy (COHL) Project. Data were collected for OHL using REALD-30, caregiver-reported COHS using the NHANES-item, and COHRQoL using the Early Childhood Oral Health Impact Scale (ECOHIS). We also measured oral health behaviors (OHBs) and socio-demographic characteristics and calculated overall/stratified summary estimates for OHL and C-OHRQoL. We computed Spearman's *rho* and 95% confidence limits (CL) as measures of correlation of OHL/COHS with C-OHRQoL. To determine whether OHL modified the association between COHS and C-OHRQoL, we compared literacy-specific summary and regression estimates.

Results—Reported COHS was: excellent—50%, very good—28%, good—14%, fair—6%, poor—2%. The aggregate C-OHRQoL mean score was 2.0 (95% CL:1.4, 2.6), and the mean OHL score 15.9 (95% CL:15.2, 16.7). There was an inverse relationship between COHS and C-OHRQoL: *rho*=-0.32 (95% CL:-0.45, -0.18). There was no important association between OHL and C-OHRQoL; however, deleterious OHBs were associated with worse C-OHRQoL. Literacy-specific linear and Poisson regression estimates of the association between COHS and C-OHRQoL departed from homogeneity (Wald X^2 P<0.2).

Conclusion—In this community-based sample of caregiver/child dyads, we found a strong correlation between OHS and C-OHRQoL. The association's magnitude and gradient were less pronounced among caregivers with low literacy.

Keywords

Oral Health Literacy; *Oral Health-related Quality of Life*; *Children*; *Early Childhood*; *Subjective Oral Health*; *REALD-30*

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Introduction

The significance of multi-level consequences of childhood oral diseases is gaining the acknowledgment of professional societies and other stakeholders [1-6]. Above and beyond their clinical sequelae, early childhood caries (ECC) and orofacial trauma are the most prevalent dental conditions that confer well-documented psychological, social, and financial impacts on both the child and the family [2,7]. Despite improvements in many oral health indicators over the last decades, ECC in particular has increased among vulnerable pediatric populations in the US and beyond [8,9]. This is a major public health issue because dental caries may affect children's social and psychological well-being and has been linked to missed school days, parental lost work time, direct and indirect costs, and more [10-13].

Caregivers' perceptions of their young children's oral health status (COHS) are uniquely valuable when considering childhood oral health because vulnerability to ECC has been linked to family- and parent-level factors [14-17]. Early childhood oral health behaviors, such as nighttime bottle feeding, snacking, and juice consumption, have been linked to parental level of education and at the same time, oral hygiene, decisions about utilization of dental services, and dental care are the exclusive domain of the caregiver [14,18,19]. Consequently, determinants of dental care-seeking behaviors are likely to include family-level characteristics such as awareness and recognition of oral conditions or symptoms, as well as the extent to which parents value oral health [20-24]. Although there is a dearth of evidence in this dimension, Talekar and colleagues [25] found a good correlation between parental reports and actual clinical dental status of children.

Measures of child oral health related quality of life (C-OHRQoL) encompass the broad spectrum of childhood oral disease impacts [26-27]. Instruments that are age-specific for children have been developed only recently and include versions of the parent and child components of the Child Oral Health Quality of Life Questionnaire [28-29] and the Early Childhood Oral Health Impact Scale (ECOHIS) [30]. Due to the inclusivity of a variety of child- and family-level impacts, C-OHRQoL instruments are considered valid and sensitive measures of the sequelae of oral disease [27]. For example, they have been employed to measure the impact of oral conditions and diseases [31], assess the effect of parental factors [32] and assess C-OHRQoL changes after various treatments [33-36].

Oral health literacy (OHL) has emerged as an important determinant of oral health [37]. OHL has been defined by the National Institutes of Dental and Craniofacial Research (NIDCR) as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions" [38]. Recent research has confirmed an association of low OHL with a plethora of outcomes such as worse oral health status, dental neglect, increased OHRQoL impacts, and sporadic use of dental services [39-41]. Because of its pivotal role in one's ability to recognize oral health information and act upon it, we anticipate that OHL may affect the manner in which caregivers' report their children's oral status, as well as their perception and experience of oral health-related child- and family-level impacts. Specifically, we hypothesized that low caregiver OHL would be associated with worse C-OHRQoL, but also with decreased caregiver perception/report of C-OHRQoL impacts. Accordingly, the aims of this investigation were 1) investigate the association of OHL with C-OHRQoL and 2) explore the role of OHL as a modifier in the association between early childhood OHS and C-OHRQoL.

Materials and methods

Study design and population

We relied upon interview data from the Carolina Oral Health Literacy (COHL) project [39], a prospective study examining the OHL's relationship with health behaviors and health outcomes among caregivers, infants, and children enrolled in the Women, Infants and Children's (WIC) Supplemental Food Program in seven counties of North Carolina (NC) in the United States of America. COHL used purposeful quota sampling [42] to ensure adequate study sample representation of minority groups (African Americans and American Indians). To minimize potential non-random data missingness associated with low literacy two trained research assistants undertook all data collection via structured interviews.

After excluding men (N=49, 3.5% of total), Asians (N=12, 0.9% of total) and those who did not have English as their primary language (N=79, 5.6% of total), there were 1,280 caregiver/child dyads in the COHL cohort. A detailed description of the caregiver/child dyads cohort, as well as the association of OHL with early childhood oral health outcomes, has been reported by Vann and colleagues [18].

The analytical sample for the present investigation was limited to a subset of the previously reported COHL project dyads [18] that included all caregivers with children ages 3-5 who completed the Early Childhood Oral health Impact Scale (ECOHIS) instrument because ECHOHIS has been validated only in the preschool-age population [30]. Due to a protocol deviation, the instrument was administered to four caregivers with children younger than 36 months (two were 33, one was 34 and one was 35mos). We included these observations in the final analytical sample that included 203 caregiver/child dyads.

Variables and instruments

We measured OHL with REALD-30, a validated word recognition literacy test [43], where 0=lowest literacy and 30=highest literacy. To date there are no norms established to indicate a score for “adequate” OHL. As in a previous investigation, we relied upon an arbitrary cutoff of <13 to indicate “low” OHL [18]. This cutoff point also represented the lowest quartile of OHL scores distribution among our analytical sample and therefore, using this threshold, 25% of our sample (N=51) was classified as “low” OHL. The children's oral health status was assessed with the National Health and Nutrition Examination Survey (NHANES) item: “How would you describe the condition of your child's teeth?” Answers to this question were coded as: 5=“excellent”, 4=“very good”, 3=“good”, 2=“fair” and 1=“poor”.

We measured C-OHRQoL with ECOHIS, an instrument designed to capture oral health impacts on preschool children and their families [30]. ECOHIS has been validated in a convenience sample of mostly high-income parents of 5 year-old children and has been shown to possess good psychometric properties and internal consistency. The range of aggregate ECOHIS score is 0-52; 0-36 for the child (CS) and 0-16 for the family scale (FS). Cronbach's *alpha* was 0.95 for the FS and 0.91 for the CS, and these scales correlated well among themselves with a Spearman's *rho* of 0.36 [30].

The authors of ECHOIS recommended [30] that the instrument be tested among parents of younger children and other study groups to establish its external validity. Subsequently, ECOHIS has been adapted and validated in several other languages including French [44], Portuguese [45], Chinese [46], and Farsi [47]. Although the two distinct ECOHIS sub-scales were originally proposed to measure child- and family-level impacts, other authors have considered the aggregate ECOHIS score as a measure of overall impact [31,34,35,48]. In

this study we computed both total and sub-scale OHS-specific estimates but for analytical purposes, we focused only upon the total (aggregate) ECOHIS score.

We assessed children's oral health behaviors (OHBs) for nighttime bottle feeding, frequency of juice intake, and consumption of sweets. The range of responses for nighttime bottle feeding were “never”, “sometimes”, and “usually”, whereas for feeding behaviors they were “never/occasionally”, “once a day”, and “more than once a day”. Demographic variables included caregiver's age, education, and race, which was self-reported and defined as White, African American (AA) or American Indian (AI), and coded as an indicator variable. Age was measured in years and coded as a quartile-categorical variable. Education was coded as a four-level categorical variable where 1=less than high school, 2=high school or GED, 3=some technical or college, and 4=college degree or higher.

Analytical approach

Our analyses relied on descriptive, graphical, parametric, and non-parametric methods. We examined the internal consistency of ECOHIS instrument by obtaining Cronbach's *alphas* for the entire scale, as well as for FS and CS. We computed descriptive statistics (means, standard errors, and ranges) of C-OHRQoL and OHL scores for strata of demographic and behavior variables. We examined the distribution of OHL and C-OHRQoL scores with histograms and tested the assumption of normality using a combined skewness and kurtosis test [49] and a $P<0.05$ criterion. To quantify the association of OHL and COHS with C-OHRQoL, we used Spearman's *rho* and 95% confidence limits (CL), estimated using bootstrapping (n=1,000 repetitions). We embraced Spearman's *rho* and ANOVA-based R^2 to obtain estimates of correlation between the two subscales of the C-OHRQoL measure.

To determine whether OHL modified the association between COHS and COHRQoL, first we empirically inspected literacy-stratified C-OHRQoL mean scores for categories of OHS, as well as bar graphs. Next we utilized multivariate linear regression to model the association between OHS and C-OHRQoL, including race, education, and age as *a priori* confounders. We used a Wald X^2 test (with a conservative P-value threshold of <0.2) to test formally the hypothesis of a common estimate (homogeneity) of the association between OHS and C-OHRQoL between strata of literacy [50]. Because previous investigators [31,32] employed Poisson regression to model the particularly skewed distribution of C-OHRQoL scores, we repeated the evaluation of effect measure modification (EMM) using multivariate Poisson regression models. For both contrasts of estimates, the homogeneity statistic was distributed with one degree of freedom (number of strata – 1) and computed as follows: $X^2= [(\beta_{low}-\beta_{common}]^2 + [(\beta_{high}-\beta_{common})^2/se_{high}^2]$. For all analyses, we relied upon the statistical program Stata 11.1 (Stata Corp LP, College Station, TX, USA) for all analyses.

Results

The distribution of OHL and C-OHRQoL scores by demographic and behavior variables is presented in Table 1. The total C-OHRQoL score was right-skewed (D’Agostino X^2 $P<0.05$) with mean=2.0 (95% CL= 1.4, 2.6) and range=0-28. Cronbach's *alpha* was 0.86. The child scale revealed a mean of 1.2 (95% CL= 0.8, 1.5) with a range of 0-19 and an *alpha* of 0.79. The family scale revealed a mean of 0.8 (95% CL: 0.5, 1.1) with a range of 0-12 and *alpha* of 0.75. The two scales were strongly correlated with Spearman's *rho* of 0.46 (95% CL=0.32, 0.61) and $R^2=0.64$. The OHL score was distributed normally (D’Agostino X^2 $P>0.05$) with a mean of 15.9 (95% CL= 15.2, 16.7) and range of 2-29.

Caregivers’ and children's median age was 27 years (range=18-57) and 43 months (range=33-59), respectively. Two-thirds of caregivers had high school diploma, GED, or less, 41% were Whites, 36% AAs and 23% AIs. One-third reported a history of nighttime

bottle use and more than 40% reported the child's juice consumption as greater than once daily. Pronounced gradients were noted in literacy scores between racial and age groups, as well as levels of education. The caregivers' educational level was inversely related to C-OHRQoL scores, which varied by caregivers' age. The examination of deleterious child oral health practices, particularly nighttime bottle feeding and frequency of sweets consumption, revealed these OHBs to be associated with lower OHL and worse C-OHRQoL.

The distribution of caregiver-reported COHS was: excellent—50%, very good—28%, good —14%, fair—6 %, and poor—2 % (Table 2). Better C-OHS was associated with decreased ECOHIS scores: *rho*=-0.32 (95% CL= -0.45, -0.18) while OHL was weakly correlated with C-OHRQoL: *rho*=0.10 (95% CL= -0.03, 0.23). Comparison of literacy-specific estimates in Table 2 indicated that OHL, despite its weak association with C-OHRQoL, has the properties of an effect modifier. This is illustrated as well with the stratified bar graphs in Figure 1, where it is evident that among caregivers with "low" literacy (<13 REALD-30), the magnitude and gradient of the association between OHS and C-OHRQoL was less pronounced.

The multiple linear regression estimates of the association between COHS and C-OHRQoL were: entire sample: β=-1.6 (95% CL=-2.2, -1.0)]; "low" literacy (<13 REALD-30 score): β=-0.9 (95% CL=-1.7, -0.1)]; "high" literacy (≥13 REALD-30 score): β=-2.0 (95% CL=-2.7, -1.3)]. We rejected the assumption of homogeneity (X^2=4.1, df=1, P<0.2). The modifying role of OHL was again evident when comparing crude (unadjusted) linear regression estimates of the association between COHS and C-OHRQoL (data not shown). Similarly, effect measure modification was confirmed with the contrast of Poisson derived Incidence Rate Ratio (IRR) estimates: entire sample: IRR=0.55 (95% CL=0.51, 0.59)]; "low" literacy (<13 REALD-30 score): IRR =0.63 (95% CL=0.52, 0.75)]; "high" literacy (≥13 REALD-30 score): IRR =0.54 (95% CL=0.50, 0.59)]; homogeneity X^2=2.0, df=1, P<0.2.

Discussion

This is the first investigation to examine the role of caregivers' oral health literacy juxtaposed to their children's oral health status and C-OHRQoL. Oral health literacy was weakly associated with C-OHRQoL, however, as hypothesized it emerged as a significant modifier of the association between COHS and C-OHRQoL. We found a strong association between children's oral health status and C-OHRQoL in our sample of female caregivers and their preschool aged children. Deleterious behaviors such as nighttime bottle feeding and frequent sweet snacking were also associated with increased C-OHRQoL impacts.

Our study sample was comprised of non care-seeking community-based caregivers of 3-5 year olds and minority groups were well-represented, with 36% AA and 23% AI caregivers, factors that offer advances over previous investigations and increase the external validity of our findings. Of special note is the lower internal consistency of ECOHIS in our sample *versus* the validation study reported for high-income caregivers of 5-year old children [30].

We acknowledge that a potential study limitation of our findings is the inclusion of only female caregivers; additionally, only less than 10% of our caregivers reported fair or poor child oral health status. By contrast, 23% of parents rated their 0-5 year old children's oral health status as poor in a study that used a modified version of ECOHIS by Wandera and colleagues [51]. This limits our inferential potential for these strata. Furthermore, the cross-sectional nature of this investigation limits our potential to make any causal inferences with regard to pathways that may link low caregiver literacy with early childhood oral health outcomes and C-OHRQoL. However, the COHL project is prospective in nature, and upon

analyses of follow up data of children's dental utilization, type of dental services and related costs, we anticipate gaining more insights into these hypothesized pathways.

The estimate of C-OHRQoL impacts (mean=2.0) in the present investigation is lower but comparable to the one reported by Goettems and colleagues [32] among non-care seeking samples of pre-school children. These authors reported a mean total score of 3.3 among a group of children (mean age= 43 months) participating in a national immunization campaign. In the Klaasen trial [35] among parents and children (mean age=48 months) referred for comprehensive treatment in specialized clinic, the baseline mean ECOHIS score was high, with a mean of 12.7. Care-seeking parents of children 2-5 years old attending a dental school screening program revealed a mean ECOHIS of 9.2 [31] while Lee and colleagues [34] reported caregivers of caries-free children to have a mean ECOHIS score of 2.9 *versus* 15.0 among parents of children with ECC. Du and colleagues [48] calculated ECOHIS scores on a 13-65 range; had these investigators used conventional scoring, mean ECOHIS score for healthy and cerebral palsy children would be 3.1 and 6.0 respectively.

Poor COHS was associated with increased C-OHRQoL impacts. Indeed, deleterious oral health behaviors such as nighttime bottle feeding and increased frequency of sweets consumption (that were associated with worse C-OHRQoL) can be considered a link in the causal chain that links literacy with poor oral health outcomes [18], although this effect may be weak [52]. It should be acknowledged that the accuracy of caregivers' reports in all domains of their children's quality of life can be questioned [53]. Further, it must be underscored that caregivers' perceptions are pivotal in initiating and sustaining oral health care for their children [54]. Evidence of marked differences in ECOHIS scores between care-seeking and non-care-seeking subjects is in concordance with a problem-initiated dental attendance pattern. Moreover, as an oral health-specific measure, ECHOHIS has been shown to perform better than generic child quality of life instruments in the oral health context [48,55].

Addressing children's unmet dental needs is an under-appreciated problem that warrants a systemic approach [56]. Watt and colleagues [57] recognized that oral health promotion efforts often are constrained by the lack of appropriate and high quality outcome measures. In the health context, literacy [58] is a recognized threat to the validity and performance of measures typically used in oral health research. In the present study, we hypothesized and confirmed that caregivers with low literacy may perceive or report subjective C-OHRQoL impacts differently *versus* those with higher literacy. In particular, the modifying effect of OHL corresponded to less pronounced gradient of the association between OHS and C-OHRQoL. This is consistent with Wilson and Cleary's modified conceptual model of patient outcomes [59] on which Wandera et al. [51] based their examination of the relationship of psychosocial factors with C-OHRQoL. This finding can be attributed to a different threshold of caregiver recognition or report of C-OHRQoL impacts relative their children's oral health status and one potential implication for oral health research is that low literacy may be associated with under-reporting of symptoms or quality of life impacts. To strengthen this link, the validity of caregivers' reports of COHS should be examined across literacy levels.

Recently Mejia and colleagues [60] reported an inverse association between low parental functional health literacy and the presence of sealants on their third-grade children. Because OHL is been increasingly recognized as component of oral health disparities and is regarded as a vehicle to reduce them [61], further investigations are warranted to examine the potential role of OHL as a modifier of caregivers' self-reports among larger and more diverse population-based samples. Based on this study's findings we recommend that participants' OHL be considered in the design and interpretation of studies that examine health behaviors, outcomes, and quality of life impacts. We envision that the widespread

reliance on OHL as a valuable component in clinical practice [62] and research [63] will be facilitated with the development of short, easily administered OHL screening instruments.

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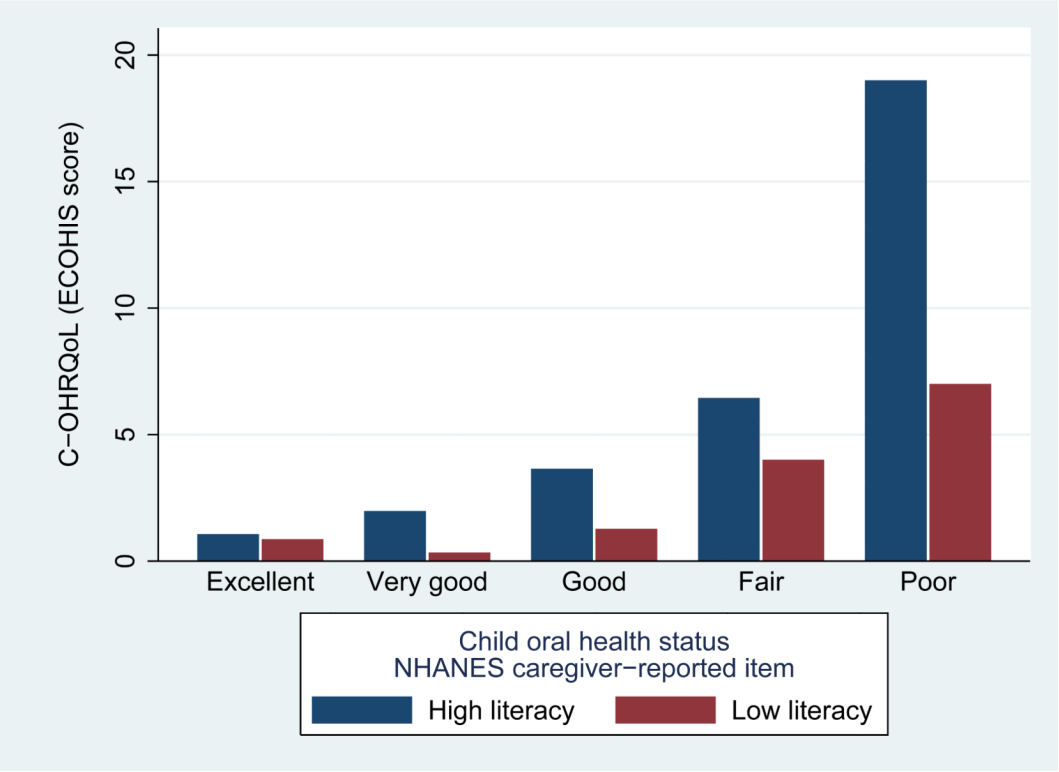

Figure.
Bar graphs illustrating the mean child oral health related quality of life scores (ECOHIS) by caregiver-reported child oral health status, for strata of caregiver oral health literacy (OHL; "low" literacy: <13 REALD-30; "high" literacy: ≥13 REALD-30) among the 203 caregiver-child dyads participating in the Carolina Oral Health Literacy (COHL) project.

Table I

Distribution of Early Childhood Oral Health- Related Quality of Life (C-OHRQoL-ECOHIS) and Oral Health Literacy (REALD-30) scores [(mean and 95% confidence limits (CL)] by caregiver demographic characteristics and Child Oral Health Behaviors among the COHL-ECOHIS study caregiver-child dyads (n=203).

			C-OHRQoL	OHL
Demographics	**n**	**%**	**ECOHIS total score (95% CL)**	**REALD-30 score (95% CL)**
Entire sample	203	100	2.0 (1.4, 2.6)	15.9 (15.2, 16.7)
Race				
White	84	41.4	1.8 (1.1, 2.6)	17.6 (16.6, 18.7)
African American	73	36.0	1.7 (0.7. 2.6)	15.2 (14.1, 16.3)
American Indian	46	22.7	2.7 (0.9, 4.4)	14.0 (12.4, 15.7)
Education				
Did not finish high school	61	30.0	2.2 (1.1, 3.3)	12.8 (11.6, 13.9)
High school diploma of GED	72	35.5	2.3 (0.9, 3.6)	15.9 (14.9, 16.9)
Some technical or college	58	28.6	1.4 (0.8, 2.1)	17.8 (16.6, 18.9)
College degree or higher	12	5.9	1.4 (0.0, 2.8)	23.5 (20.9, 26.1)
Age quartiles (years)		Mean(SD)		
Q1 (range: 18.3-23.7)	51	21.8(1.4)	2.9 (1.3, 4.4)	14.7 (13.3, 16.1)
Q2 (range: 23.7-27.1)	51	25.0(1.0)	1.5 (0.4, 2.7)	16.8 (15.6, 18.0)
Q3 (range: 27.1-30.7)	51	28.8(1.1)	1.2 (0.5, 1.9)	15.5 (13.9, 17.2)
Q4 (range: 30.8-57.1)	50	36.1(5.4)	2.2 (0.9, 3.5)	16.8 (15.3, 18.3)
Child Oral Health Behaviors				
Have put the child in bed with bottle				
Never	132	65.0	1.2 (0.8, 1.6)	16.3 (15.4, 17.3)
Sometimes	38	18.7	2.8 (1.0, 4.6)	14.6 (12.9, 16.2)
Usually	33	16.3	4.0 (1.4, 6.6)	15.9 (14.4, 17.5)
Frequency of juice consumption				
Never/Occasionally	59	29.1	2.0 (0.9, 3.1)	15.6 (14.4, 16.9)
Once a day	59	29.1	1.6 (0.7, 2.5)	16.1 (14.6, 17.6)
More than once a day	85	41.9	2.2 (1.1, 3.2)	16.0 (15.0, 17.1)
Frequency of sweet snacks consumption				
Never/Occasionally	122	60.1	1.2 (0.7, 1.7)	16.1 (15.2, 17.1)
Once a day	50	24.6	2.7 (1.3, 4.1)	15.8 (14.3, 17.3)
More than once a day	31	15.3	3.7 (1.1, 6.3)	15.4 (13.6, 17.2)

Table II

Early Childhood Oral Health- Related Quality of Life (C-OHRQoL-ECOHIS) scores [(mean and standard deviation (SD)] by caregiver-reported Child Oral Health Status (COHS) for the entire study sample (n=203) and stratified by oral health literacy (OHL) level ("high" OHL: ≥13 REALD-30; "low" OHL: <13 REALD-30 score).

Child OH Status			C-OHRQoL-ECOHIS		
	n	%	Total score (SD)	Family scale (SD)	Child scale (SD)
Entire sample					
Excellent	101	49.7	1.0(3.1)	0.4 (1.2)	0.6 (2.1)
Very good	57	28.1	1.6(2.6)	0.8 (1.6)	0.9 (1.4)
Good	28	13.8	2.7(5.6)	0.8 (1.9)	0.8 (4.1)
Fair	13	6.4	5.7(6.3)	2.4 (2.7)	1.1 (3.9)
Poor	4	2.0	13(11.1)	6.8 (5.1)	3.1 (6.3)
"High" OHL					
Excellent	79	52.0	1.1(3.2)	0.4 (1.2)	0.7 (2.2)
Very good	45	29.6	2.0(2.9)	1.0 (1.8)	1.0 (1.5)
Good	17	11.2	3.6(6.8)	1.1 (2.3)	2.6 (5.1)
Fair	9	5.9	6.4(6.3)	2.8 (2.6)	3.7 (4.1)
Poor	2	1.3	19.0(11.3)	9.0 (4.2)	10.0 (7.1)
"Low" OHL					
Excellent	22	43.1	0.9(2.8)	0.4 (1.1)	0.5 (1.7)
Very good	12	23.5	0.3(0.7)	0.0 (0.0)	0.3 (0.7)
Good	11	21.6	1.3(2.2)	0.5 (0.9)	0.8 (1.6)
Fair	4	7.8	4.0(6.7)	1.5 (3.0)	2.5 (3.8)
Poor	2	3.9	7.0(9.9)	4.5 (6.4)	2.5 (3.5)