

# Does oral health affect self perceptions, parental ratings and video-based assessments of children's smiles?

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**Abstract – Objectives:** To explore whether there is a relationship between children's objectively determined oral health status and their oral health-related quality of life, specifically the evaluations of their smiles as assessed by the children, their parents, and through measurements of the children's videotaped smiles. **Methods:** Chart review data were collected from 99 children (56 boys, 43 girls; average age: 7.06 years; range: 4–12 years) to determine their oral health status. The children responded to the Michigan Oral Health-Related Quality of Life Scale – Child Version (MOHRQOL-C), and the parents responded to the Michigan Oral Health-Related Quality of Life Scale – Parent Version (MOHRQOL-P) to assess the smiling-related aspect of the children's oral health-related quality of life. Parents also responded to questions concerning their own evaluations of their child's smile. The children were videotaped while they watched a funny cartoon. Two independent raters measured the width and openness of the children's mouth plus the number of teeth shown at 25 predetermined time points during these taped sessions to assess the children's video-based smiling patterns. **Results:** The children's self evaluated smile scores correlated with the video-based ratings of the children's smiles, and with the number of positive adjectives parents chose to describe their children's smiles. There were significant relationships between several indicators of oral health status and all smile assessment scores. Children without caries evaluated their own smiles more positively, showed more teeth when smiling, and received more positive parent evaluations for their smiles than children with decay. **Conclusion:** Poor oral health is significantly related to children's smiling patterns and the way others perceived their smiles. Poor oral health may prevent children from expressing positive emotions, which can impact their social interactions and the way they feel about themselves.

**Key words:** children; facial esthetics; oral health; oral health-related quality of life; smiling

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## Introduction

In the year 2000, the US Surgeon General Report on Oral Health provided some striking evidence for the fact that children in the US are one of the population groups with high rates of oral disease and a remarkable lack of access to care. This report showed that caries is the single most common

chronic childhood disease (1, 2). Data from the 1988–1994 NHANES III data set showed that caries affected 18% of young children between 2 and 4 years of age, 52% of children between 6 and 8 years of age, and 61% of adolescents by the age of 15 years (3). The percentage of untreated dental decay was 16% in young children aged 2–4 years, 29% in children aged 6–8 years, and 20% in

adolescents by the age of 15 years in the USA. Children from underrepresented minority groups and/or from socioeconomically deprived groups are especially vulnerable to caries and to not receiving the dental care they need (4). In addition, available preventive measures such as dental sealants are still largely underutilized for these groups of children.

The consequences of oral disease in children are well documented. Research clearly showed that caries in the primary dentition is a significant predictor of caries in the permanent dentition (5–9). In addition, caries is a major reason for emergency room visits (10), with the reported proportions of child emergency room visits attributable to caries ranging from 17% to 49% (11, 12). Research also showed that impaired oral health can cause insufficient development in children who have no other medical problems (13–15), and that poor oral health is related to children's general health status as well as their weight (14, 16–18) and height (19). An additional well documented consequence of children's poor oral health is that it affects their school attendance and the number of days with restricted activity (20, 21). Given all these severe consequences, it is not surprising that impaired oral health also affects children's quality of life (17, 22, 23). Children's oral health-related quality of life considers how functional factors (such as whether children can speak clearly, chew or bite), pain and discomfort caused by oral health problems as well as psychological factors (such as concerns about the child's appearance and self-esteem) and social factors (such as whether children's oral health interferes with their interactions with others in school or during play activities) are affected by the child's oral health (24). Research clearly demonstrated the impact of severe dental caries and its rehabilitation on a child's oral health-related quality of life (17, 25, 26).

Children's smiling patterns are related to their oral health-related quality of life in two ways. First, children's self perceptions of their smiles are part of the psychological aspect of their oral health-related quality of life. Part of the assessment of children's oral health-related quality of life consists of questions concerning how much the children like their smiles and how happy they are with their smiles (17). Second, the way children may smile, i.e., the degree to which they have an open and relaxed smile, could also be seen as related to the social aspects of their oral health-related quality of life, especially how at ease they feel in social

interactions, in school settings or during play activities with other children.

Why would it be important to explore the relationship between oral health and this particular aspect of children's oral health-related quality of life? Research showed that smiling is of great importance, both for a person's interactions with others as well as for a person's mood and self-concept. Reis et al. (27) published an article with the provocative title "What is smiling is beautiful and good." This title touched on the significant role that smiling has on others' evaluations of a person. The study showed that smiling affected judgments of physical attractiveness and other characteristics typically ascribed to attractive persons (27). In particular, smiling faces were evaluated as being more sincere, more sociable, and more competent than non-smiling faces. The findings clearly showed how strongly positive smiling patterns affected how others evaluated a person. Källestål et al. (28) showed that a confident smile was linked to the communication of positive self-esteem, self-confidence, and overall well-being. By responding with or without a smile, children communicated to others whether they felt happy or sad, confident or uncertain. More specifically to dentistry, Low et al. (25) showed that children with worries about their teeth, and children with missing, stained or decayed teeth were less confident about smiling. Research with adults replicated this finding by showing that there was a relationship between missing teeth and quality of life (25). Adults with missing teeth not only limited their food choices because of chewing problems, but also felt embarrassed and self-conscious and limited their social interactions and face to face communication with others. In summary, understanding the relationship between oral health and a person's smile specific oral health-related quality of life could contribute to gaining a better understanding of the impact that poor oral health has on our patients' lives.

Figure 1 provides an overview of the theoretical relationships explored in this study. The objectives are to investigate whether children's oral health status affects the three separate assessments of these aspects of their oral health-related quality of life and whether children, parents and video-based smile assessments are consistent. It will be investigated whether children's self reported satisfaction with their smiles, the parents' proxy evaluations of how much their children like their smiles, and the parents' own evaluations of their children's smiles, as well as the video-based assessed smiling pat-

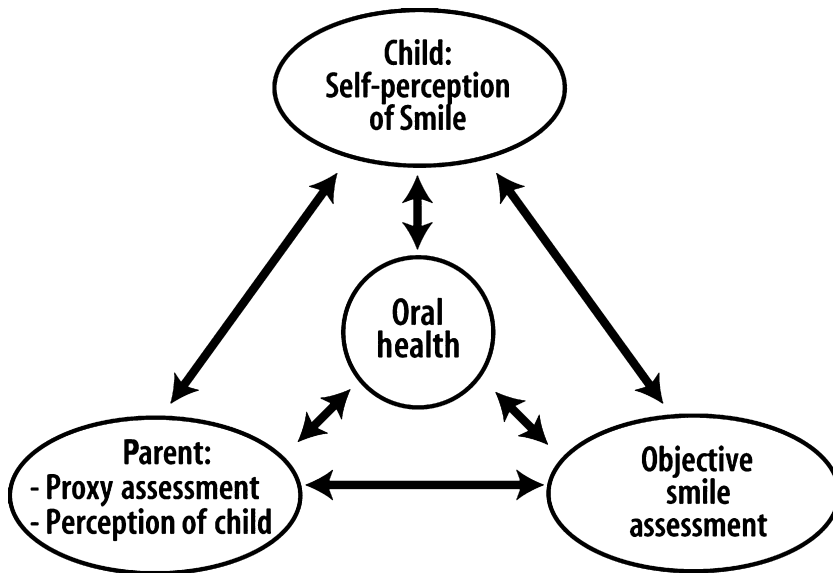


Fig. 1. Overview of the theoretical relationships investigated.

terns are related to each other as well as to the children's oral health status. It is hypothesized that children's self perceptions of their smiles, their parents' proxy evaluations of their children's smiles, the parents' own assessments of their children's smiles, and video-based smiling patterns are not only correlated with each other (hypothesis 1), but that in addition, children's oral health status, specifically the degree of caries, will be significantly correlated with these four sets of indicators (hypothesis 2).

## Methods

This research was conducted at the Pediatric Dental Clinic at the University of Michigan School of Dentistry (UMDS) in Ann Arbor, Michigan, between June 22, 2005, and July 20, 2005. The Institutional Review Board for the Health Sciences at the University of Michigan in Ann Arbor, MI, approved the research.

### Respondents

Data were collected from 99 child patients and their parents/guardians at the pediatric dental clinic. Only regularly scheduled pediatric dental patients between the ages of 4 and 12 years who were able to respond to the questions and who watched the movie consistently without being distracted and their parents/guardians were included. All children were healthy and had no developmental delays. All children and parents/guardians were fluent in English. The 56 boys and 43 girls ranged in age from 4 to 12 years (mean age = 7.06 years;

SD = 2.069). The accompanying adults were 83 mothers, seven fathers, six female and two male guardians. They ranged in age from 20 to 70 years (mean age = 36.89 years; SD = 9.089).

### Procedure

Regularly scheduled eligible pediatric dental patients and their parents/guardians were invited to participate in this study upon arrival at the dental clinic. They were informed that they would receive free parking in return for their participation. After the parents signed a written consent form and a HIPAA (Health Information Protection Act Authorization) form, and the children gave their verbal assent, the parents/guardians responded to a survey concerning their children's oral health, quality of life, and smiling patterns. The children were asked to watch a short (4 min and 30 s long) VHS tape of the cartoon character Bugs Bunny in a room by themselves. While they watched the video, their faces were being videotaped with a digital camera positioned behind the TV set. After watching the cartoon, the children answered questions concerning their oral health and smiling patterns. The digital recordings of the children's faces were converted into DVDs. Two trained independent raters evaluated each child's smile at baseline and at 25 points during the taped session. Children's dental charts were reviewed to determine the children's objective oral health status.

### Measures

#### Child survey

Questions from the Michigan Oral Health-related Quality of Life Scale – Child Version (18) related to

smiling were selected and included in the child survey. The children's survey consisted of five questions concerned with the children's smile ("Do you like your teeth?", "Are you happy with your teeth and smile?", "Do your teeth look nice?", "Do you have a nice smile?", and "Do you show your teeth when you smile?"). The children answered these questions with a simple "yes"/"no" answer. The sum of the "yes" answers was used as an indicator of the children's self evaluations of their smiles. A higher score indicated a more positive smile evaluation.

#### *Parent survey*

Five parent indices were determined. Index 1 was the parents' "proxy assessment" of their children's satisfaction with their smiles. The parents/guardians indicated on a 5-point rating scale (1 = "disagree strongly" and 5 = "agree strongly") how much they agreed with two questions from the Michigan Oral Health-related Quality of Life Scale – Parent Version (17) ("My child likes his/her smile.", "My child is happy with his/her teeth."). The average response to these items was used as the parents' proxy assessment of their children's smile evaluation. Index 2 was the parents' own evaluations of their children's smiles with an "impact score." The parents' responses to the two questions "How much do you think that the health of your child's teeth affect the way your child smiles?" and "How much do you think the condition of your child's teeth affects the way your child feels about her/himself?" were given on 5 point rating scales ranging from 1 = "not at all" to 5 = "very much." The "impact score" was computed by averaging the responses to these two items. Index 3 was a "tooth ache score." This score consisted of the parents' agreement with the statement "A tooth ache keeps my child from smiling" on a 5-point answer scale ranging from 1 = "disagree strongly" to 5 = "agree strongly." Indices 4 and 5 were the number of positive and the number of negative adjectives chosen from a list of the nine adjectives "happy," "reserved," "wide smile," "shows teeth," "hides teeth," "hesitant," "shy," "open mouth," and "closed mouth." The "number of positive items" was computed by adding one point each for checking the adjectives "happy," "wide smile," "shows teeth," and "open mouth." The "number of negative items" was computed by adding one point each for checking the adjectives "reserved," "hesitant," "hides teeth," "shy," and "closed mouth."

#### *Video-based smile assessments*

Each child was videotaped for 4 min and 30 s while watching a cartoon. A segment of these tapes starting at a certain point in the movie that was 5 s before a funny sequence began and lasting for 2 min and 30 s was transferred to a DVD. Two raters were asked to watch these DVD segments and to measure each child's smile at 26 time points. The first measurement was a baseline measurement at the beginning of the DVD tape just before a sound occurred that indicated that the funny segment of the video started. The next 25 measurements were spaced every 5 s from the time this funny sequence started. For each measurement point, the raters measured three indicators – namely the width of the child's mouth in mm, the opening of the child's mouth in mm, and the number of teeth shown. These three indicators were chosen based on considerations concerning the measurement of facial expressions (29). Each rater worked independently watching the DVDs on identical computer screens. They measured the three characteristics for each of the 26 time points considered for each child.

"Mouth width" was determined by standardizing each of the 25 width measurements by dividing it with the child's baseline smile measurement before the funny sequence of the movie started. These 25 standardized scores for each of the two raters were averaged. A score of "1" would indicate that the child's mouth width at baseline and when watching the movie did not change, while a score of "<1" would indicate that the child's mouth was narrower when watching the funny movie, and a score of ">1" that it was wider. The average "width" scores of the two raters correlated significantly ( $r = 0.74$ ;  $P < 0.001$ ). The two average "width" rating scores were therefore averaged and used as an indicator of the children's "mouth width." The "mouth opening in mm" and "number of teeth shown" scores were the average scores for all 25 measurements and both raters. The opening scores, and the number of teeth scores of the two raters correlated significantly ( $r = 0.88$ ;  $P < 0.001$ ;  $r = 0.95$ ;  $P < 0.001$ ). The scores of the two raters were thus averaged, and the mean ratings were used as indicators of the videotaped smile ratings.

#### *Chart review*

A dental chart review was conducted to record children's oral health indicators such as the number of decayed, missing, and filled surfaces of

primary teeth due to caries (dmfs), the number of decayed, missing, and filled primary teeth (dmft) scores, and the number of clinically and radiographically determined abscesses. It should be noted that the number of decayed, missing, and filled permanent teeth due to caries was not used as an indicator of oral health in these analyses because of the wide age range of the study participants (4–12 years). The number of teeth missing in the front and the total number of missing teeth were also determined based on the patient record. In addition, children's plaque scores and current gingival health scores were recorded.

## Results

### *Self evaluations, parents' evaluations, and video-based assessments of children's smiles*

The children's self evaluations of their smiles – as measured with the number of positive self descriptions – was significantly correlated with the average ratings of the video-based assessments "mouth openness" ( $r = 0.29$ ;  $P = 0.005$ ) and "number of teeth shown" ( $r = 0.38$ ;  $P < 0.001$ ) (see Table 1). In addition, the children's self report was also significantly correlated with two parent measures, namely with the parents'/guardians' responses to the item "A tooth ache keeps my child from smiling" ( $r = -0.23$ ;  $P = 0.029$ ), and the number of positive adjectives chosen ( $r = 0.23$ ;  $P = 0.025$ ). The more the parents thought that a toothache kept their child from smiling, the less positive the children were about their smiles. However, the more positive the children were about their smiles, the more

positive adjectives the parents had chosen to describe their children's smile. In summary, the results supported the hypothesis that children's self evaluations of their smiles are correlated with the video-based assessments of their smiles, and parents'/guardians' evaluations of their children's smiles. It is noteworthy that the parents' proxy assessment did not correlate significantly with the children's self assessment. This score was however correlated with the "impact score" ( $r = 0.27$ ;  $P = 0.009$ ) and the "number of negative items chosen" ( $r = -0.28$ ;  $P = 0.007$ ).

### *Oral health and self evaluations, parents' evaluations, and video-based assessments of children's smiles*

The children's self reports correlated consistently and significantly with all but two of the oral health indicators. It correlated with the number of decayed, missing, and filled surfaces of the children's primary teeth ( $r = -0.57$ ;  $P < 0.001$ ), and the number of decayed, missing, and filled primary teeth ( $r = -0.47$ ;  $P = 0.002$ ) (see Table 2). In addition, the children's self evaluations of their smiles also correlated significantly with the number of missing anterior teeth ( $r = -0.30$ ;  $P = 0.002$ ), the total number of missing teeth ( $r = -0.33$ ;  $P = 0.001$ ), the total number of restored teeth/crowns ( $r = -0.29$ ;  $P = 0.005$ ), their gingival health ( $r = -0.45$ ;  $P < 0.001$ ), their plaque score ( $r = -0.23$ ;  $P = 0.33$ ), and whether decay was present radiographically ( $r = -0.38$ ;  $P < 0.001$ ). In addition, it should be noted that a stepwise regression analysis with the dependent variable "children's self evaluations" and these oral health

Table 1. Correlations between the children's self reports, the parent proxy and own assessments, and the video-based smile assessments

	Children: self report	Parents					Video-based assessment	
		Proxy score	Parent score	"Tooth ache"	No. positive adjective	No. negative adjective	Width	mm open
Parent								
Proxy score	0.11	1						
Impact score	0.04	0.27***	1					
Tooth ache	-0.23**	-0.12	0.15	1				
No. positive adjectives	0.23**	0.13	-0.21**	-0.28***	1			
No. negative adjectives	-0.153	-0.28***	0.12	0.28***	-0.38***	1		
Video								
Width	0.19*	0.12	-0.01	-0.09	0.06	-0.00	1	
mm open	0.29***	0.05	0.10	-0.13	0.11	-0.13	0.19*	1
No. teeth	0.38***	0.04	0.11	-0.15	0.18*	-0.11	0.19*	0.82***

\* $P < 0.10$ ; \*\* $P < 0.05$ ; \*\*\* $P < 0.01$ ; \*\*\*\* $P < 0.001$ .

Table 2. Correlations between objective oral health indicators and child self evaluations, parent proxy and own evaluations, and video-based assessments of the children's smiles

	Parents			Video-based assessments					
	Child: self report	Proxy score	Impact score	Tooth ache	No. positive adjective	No. negative adjective	Width	mm open	No. teeth
dmfs – primary teeth	-0.57***	-0.34***	-0.15	0.20*	-0.23**	0.25**	-0.25**	-0.21**	-0.29***
dmft – primary teeth	-0.48***	-0.33***	-0.19*	0.10	-0.19*	0.19*	-0.23**	-0.22**	-0.31***
Teeth missing in front	-0.31***	0.01	0.03	0.14	-0.16	0.04	0.00	-0.02	-0.13
Abscesses present clinical	-0.379***	-0.05	0.00	0.09	-0.09	0.14	-0.05	0.00	-0.13
Abscesses present on X-ray	-0.11	-0.26**	-0.24**	-0.05	-0.09	0.00	-0.21*	-0.01	0.30
Decay present clinical	-0.19*	-0.23**	-0.23**	-0.04	-0.03	0.01	-0.22**	-0.00	-0.08
Decay present on X-rays	-0.38***	-0.19*	-0.12	0.09	-0.14	0.17	-0.15	-0.21**	-0.22**
No. restored teeth/crowns	-0.29***	-0.32***	-0.08	0.30***	-0.15	0.26**	-0.19*	-0.21**	0.01
No. extracted teeth	-0.30***	-0.04	-0.07	0.14	-0.164	0.05	-0.13	-0.04	-0.10
No. teeth missing (caries)	-0.33***	-0.04	0.02	0.14	-0.17*	0.09	-0.15	-0.08	-0.08
No. teeth missing(natural)	-0.04	-0.04	0.09	-0.00	-0.01	0.02	0.00	-0.22**	-0.18*
Plaque score (%)	-0.23**	-0.31***	-0.13	0.10	-0.18*	-0.00	-0.16	-0.01	0.04
Gingival health	-0.45***	-0.32***	-0.23**	0.09	-0.13	0.02	-0.15	-0.01	-0.03

\* $P < 0.10$ ; \*\* $P < 0.05$ ; \*\*\* $P < 0.01$ ; \*\*\*\* $P < 0.001$ .

indicators showed that the “dmfs score” and the “number of abscesses present clinically” were significant predictors of this dependent variable (standardized  $\beta = -0.486$ ;  $P < 0.001$ ; standardized  $\beta = -0.240$ ;  $P = 0.012$ ). In summary, there were significant relationships between children's evaluations of their own smiles and indicators of their oral health.

One of the two nonsignificant relationships between the self report score and the oral health indicators was between this score and the number of naturally missing teeth due to the change from the primary to the permanent dentition. It seems as if the children were not considering this temporary situation in their self reports. However, the negative correlations with the two video-based smile assessment variables “open in mm” and “number of teeth shown” showed that the children were aware of this temporary condition and that it affected their smiling behavior.

The dmfs and dmft scores were also correlated with the parents' proxy score ( $r = -0.34$ ;  $P = 0.001$ ), the parents' responses to the tooth ache question ( $r = 0.20$ ;  $P = 0.058$ ), and the number of positive and negative adjectives chosen by the parents/guardians to describe their children's smiles ( $r = -0.23$ ;  $P = 0.029$ ;  $r = 0.25$ ;  $P = 0.017$ ) (see Table 2). In addition, the proxy scores also correlated with the dmft score ( $r = -0.33$ ;  $P = 0.001$ ), the number of abscesses present on the X-rays ( $r = -0.26$ ;  $P = 0.012$ ), the clinically present decay ( $r = -0.23$ ;  $P = 0.029$ ), and the number of restored teeth and crowns ( $r = -0.32$ ;  $P = 0.002$ ). A stepwise regression analysis with the dependent variable “number of positive adjectives chosen” showed that the dmfs score was a significant predictor of this dependent variable (standardized  $\beta = -0.263$ ;  $P = 0.016$ ).

Table 2 also shows that the three video-based assessments of the videotaped smiles, namely “mouth width,” “mouth openness,” and “number of teeth shown” are correlated with the number of decayed, missing and filled surfaces of primary teeth (dmfs) and the number of decayed, missing, and filled primary teeth (dmft) due to caries. The higher the children's dmfs and dmft scores were, the narrower were the children's smiles compared with the baseline measurement ( $r = -0.25$ ;  $P = 0.031$ ;  $r = -0.23$ ;  $P = 0.048$ ), the less open the children's mouths were ( $r = -0.21$ ;  $P = 0.042$ ;  $r = -0.22$ ;  $P = 0.038$ ), and the fewer teeth they showed ( $r = -0.29$ ;  $P = 0.006$ ;  $r = -0.31$ ;  $P = 0.003$ ) when they smiled. The clinically recorded decay

scores were also correlated with the “width of smile scores” ( $r = -0.22$ ;  $P = 0.052$ ). The less radiographically determined decay the children had, the more they opened their mouth ( $r = -0.21$ ;  $P = 0.048$ ), and the more teeth they showed ( $r = -0.22$ ;  $P = 0.033$ ). A stepwise regression analysis with the dependent variable “mouth width” and the oral health indicators showed that the “dmfs score” was a significant predictor of this dependent variable (standardized  $\beta = -0.277$ ;  $P = 0.022$ ). The stepwise regression analysis for the dependent variable “mouth openness” showed that the “dmft score” and the “number of missing teeth due to developmental causes” were significant predictors of this dependent variable (standardized  $\beta = -0.243$ ;  $P = 0.024$ ; standardized  $\beta = -0.225$ ;  $P = 0.036$ ). Finally, the stepwise regression analysis for the dependent variable “number of teeth shown” showed that “dmft score” and the “plaque scores” were significant predictors of this dependent variable (standardized  $\beta = -0.437$ ;  $P = 0.001$ ; standardized  $\beta = 0.274$ ;  $P = 0.027$ ).

In order to gain a better understanding of how the smiles of children with good oral health who had no decay differed from the smiles of children with poorer oral health who had decay either in the past or presently, group comparisons were conducted between the group of children with no decayed, missing, and filled primary teeth due to caries (group 1;  $n = 25$ ), and the group of children (group 2;  $n = 64$ ) who had at least one decayed, missing or filled primary tooth due to caries. Children in group 1 (= children with no decay) agreed on average with 4.44 of the five positive statements describing their smiles, while the children in group 2 (= with decay) agreed only with 3.38 of the five statements ( $P = 0.001$ ) (see Table 3).

The parents’ assessments of the smiles of the children in the “no decay” group also differed significantly from the assessments of the smiles in the “decay” group in several ways. First, the parents’ proxy assessments were significantly more positive for children in the “no decay” group compared with the “decay” group (4.38 versus 3.29;  $P < 0.001$ ). Second, the responses to the “toothache” question differed in the predicted way. Parents of children in the “no decay” group disagreed more strongly with this item than parents of children in the “decay” group (1.33 versus 1.91;  $P = 0.028$ ). Finally, parents of children in the “no decay” group chose on average 2.68 positive adjectives to describe their children’s

Table 3. Average child self reports, parent proxy and own assessments, and video-based assessments of smiles of children without versus with decay

	No decay ( $n = 25$ )	Decay ( $n = 64$ )	$P$
Child			
Self report of smile	<b>4.44</b>	<b>3.38</b>	<b>0.001</b>
Parents			
Proxy score	<b>4.38</b>	<b>3.29</b>	<b>&lt;0.000</b>
Impact score	3.31	2.99	n.s.
Toothache	<b>1.33</b>	<b>1.91</b>	<b>0.028</b>
No. positive adjectives	<b>2.68</b>	<b>2.04</b>	<b>0.034</b>
No. negative adjectives	1.36	1.54	n.s.
Video-based assessment			
Mouth width	25.6	24.7	n.s.
Mouth opening in mm	56.7	41.55	n.s.
No. teeth shown	<b>2.01</b>	<b>1.11</b>	<b>0.060</b>

Bold values represent significant results.

smiles compared with the parents of children in the “decay” group who chose only 2.04 positive adjectives ( $P = 0.034$ ).

There was a tendency for the children in the “no decay” group to show more teeth than the children in the “decay” group. On average, healthy children showed 2.02 teeth when they smiled, while children with decay showed only 1.11 teeth ( $P = 0.060$ ).

## Discussion

Despite the fact that caries is preventable, large numbers of children in the US still suffer from this disease. While extensive research documented the impact of caries in children on their oral health (5–9), their general health (13–19), and their oral health-related quality of life (17, 22–23), no research so far explored whether poor oral health also affects the smile-related aspect of children’s oral health-related quality of life. This research presents the first findings that show that poor oral health, especially caries in children, affects children’s self perceptions of their smiles as well as their actual smiling patterns, and parents’ evaluations of their children’s smiles. While analyses of smiling patterns might be seen as falling primarily into the domain of orthodontists or orthognathic surgeons, this study argues to consider how poor oral health in general is related to smiling. Smiling has important communicative functions (27) as well as an important impact on a person’s mood and self evaluation (25, 28). Smiling faces were evaluated as being more sincere, more sociable, and more competent than non-smiling faces (27).

Smiling, therefore, is a clear asset for every individual, and not smiling can affect social interactions, communication with others as well as mood, self-confidence, and quality of life in a negative manner (25, 27, 28). This study showed that children were aware of the degree to which they displayed positive smiles. The self evaluations of their smiles were significantly correlated with the ratings of their videotaped smiles as well as with their parents'/guardians' ratings of their smiles. In addition, parents were quite aware of the degree to which their children's smiles affected their children's quality of life. At this point, we are collecting data from adult patients to explore whether the same powerful effects of poor oral health on smiling patterns can also be found in adult patients.

Given the importance of smiling for social interaction, communication, and self perceptions, it is crucial to understand that poor oral health was significantly correlated with the children's video-based assessments of their smiling scores as well as with the children's self reported smiling scores, and their parents'/guardians' evaluations of their children's smiles. The fact that some of the significant correlations were relatively small should be interpreted in the context of the types of measurements considered. In the behavioral sciences, most measures are indicators of psychological constructs. Such measures are affected by quite a number of factors. For example, attitudinal statements such as the parents' levels of agreement with statements concerning their children's smiles might be affected by the way the respondents use the 5-point answering scales, or by personal styles of responding to surveys. Such individual differences may increase the error variance of the measurements and thus result in relatively lower correlations. However, the findings were significant – which supported the original hypothesis that children's oral health and smiling patterns are related.

In addition, the results showed that children with good oral health were significantly more likely to describe their own smiles in a positive manner, showed more teeth when they smiled, and had more positive parent evaluations of their smiles than children with poorer oral health (see Table 3). These results support the hypothesis that poor oral health affects children's smiling patterns and as a consequence their social interactions, their communication with others, and their mood and self perceptions.

When the US Surgeon General published his first ever Report on Oral Health in the year 2000, children were named as one of the population groups that had unmet oral healthcare needs (1). The findings of this study add yet another reason to the set of arguments that stresses the importance of promoting good oral healthcare practices to prevent oral disease in children, and to meet children's unmet oral healthcare needs. These findings will hopefully add to the growing evidence that child advocates can use to inform policy makers about the significance of good oral health for children's lives.

## Limitations

A possible limitation of this study was the fact that the children participated in this research while they were at a regularly scheduled dental appointment. It is possible that they would have expressed more positive emotions and smiled more while watching the movie if they had not been in a dental clinic awaiting dental treatment. In addition, independent raters rated the videotaped smiles instead of using complex computer software to measure the smiles. While the inter-rater correlations were sufficient to justify the use of this rating method to measure children's smiles, the future development of sophisticated software to measure the video-based smile characteristics would improve the already high reliability of these measurements.

## Conclusions

- Children's self evaluations of their smiles are valid assessments of their actual smiles. They were significantly correlated with video-based assessments of smiles as well as with parent/guardian positive descriptions of their children's smiles. These findings support the assumption that children were quite aware of the quality of their smiles.
- There are clear relationships between a child's oral health status and their smiles as assessed by the child, by parents, and with video-based assessments of smiles. Caries in children, as measured with the dmfs and the dmft scores were significantly correlated with children's self evaluations of their smiles, with the video-based assessments of smiles as well as with parents'/guardians' evaluations of their children's smiles. Poor oral



health clearly affected the smile-related aspects of the children's oral health-related quality of life and the ways others perceived their smiles.

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