SCIENTIFIC ARTICLE

Reliability and Validity of Brief Measures of Oral Health-related Knowledge, Fatalism, and Self-efficacy in Mothers of African American Children

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Abstract

Purpose: Low-income African American children experience high rates of dental caries compared to the general population. Knowledgeable and efficacious caregivers can play an important role in caries prevention. The purpose of this study was to develop and evaluate 4 brief measures reflecting mothers' potentially modifiable cognitions associated with African American children's oral health: (1) knowledge about appropriate bottle use (KBU); (2) knowledge about children's oral hygiene (KCOH); (3) oral health-related fatalism (OHF); and (4) oral health-related self-efficacy (OHSE).

Methods: Questions were selected based on reviews of the health promotion and oral health literature, with input from low-income African American caregivers of young children. Reliability and validity were evaluated using survey and dental examination data from 719 low-income African American mothers and their 1- to 5-year-old children.

Results: Alpha reliabilities ranged from 0.76 to 0.91. KCOH was significantly associated with mothers' oral health perceptions and children's caries status. OHSE was significantly positively correlated with children's brushing frequency and with mothers' subjective perceptions of children's oral health, which was, in turn, significantly associated with children's caries status.

Conclusions: Results support the reliability and validity of the new measures. If confirmed by further research, these measures can be used to develop tailored educational and cognitive-behavioral interventions to reduce oral health disparities. (Pediatr Dent 2005;27:422-428)

KEYWORDS: CHILD, ORAL HEALTH, AFRICAN AMERICAN, SELF-EFFICACY, MEASURES

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Although the prevalence of dental caries has dramatically decreased over the last 3 decades in the United States, significant levels of disease persist and are concentrated among socioeconomically disadvantaged groups.[1] Several studies have found that dental caries remains prevalent among lower-income households and among African American adults and children.[2-5] Early Childhood Caries (ECC) is used to describe extensive tooth decay in children under age 6. ECC's effects can interfere with optimal growth and development and significantly impair quality of life and functioning in fundamental social activities.[6] Due to examination difficulties and variation in ECC clinical diagnostic criteria,[7] ECC's prevalence in the United States is not entirely clear. The baseline prevalence, however, from the Third National Health and Nutrition Examination Survey 1988-94 (NHANES III), for all children ages 2 to 4 is 18% and for African Americans is 24%.[8]

A recent systematic review identified 106 specific sociodemographic, oral hygiene, dietary, and bacterial risk factors for ECC in children under age 6.[9] Most of the sociodemographic risk factors for oral health disparities are not readily amenable to change. A young child's primary caregiver, usually the mother, however, has control over many of the behavioral factors that can increase caries risk and can play a critical role in determining whether or not children develop ECC. Very young children are dependent on their mothers to attend to their oral hygiene and feed them. Inappropriate bottle-use patterns, such as the addition of sweeteners to the liquid and prolonged exposure of sugary liquids at bedtime,[10,11] and weaning at a later age[12] have been linked to ECC.

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Importantly, mothers can modify their child's high sugar intake, poor and infrequent brushing, and whether or not the child falls asleep with a bottle of sweet liquid. Lack of knowledge of ECC risk factors and how to care for newly erupting teeth in very young children, however, may prevent caregivers from meeting young children's oral health needs. Furthermore, although accurate knowledge is necessary, it is not always sufficient, as it is not uncommon for educationally based intervention efforts to only have modest and short-term effects.[13,14] Perceptions of self-efficacy, or judgments about the ability to perform certain behaviors like brushing a child's teeth are an important basis for action and should also be considered in interventions. Those with a strong sense of efficacy tend to set higher goals, persist longer at tasks despite obstacles, and devote more effort and energy to the task compared to those without a strong sense of efficacy.[15]

Although self-efficacy has been positively associated with favorable health outcomes,[16] research is sparse that investigates caregivers' self-efficacy in populations of children at high risk for dental diseases. Previous research generally supports a positive relationship between efficacy and oral health behaviors and outcomes,[17-22] although there are some conflicting findings.[11] Reisine and Litt[11] investigated brushing habits, dietary sugar intake, social class, stressful life events, dental health locus of control, dental self-efficacy, tooth decay, and bacteria in saliva among Connecticut Head Start children. Although not specific to brushing children's teeth, an 8-item oral health efficacy measure was associated with higher caries rates in children. In a related study, maternal efficacy was an important predictor of sugar intake, which, in turn, predicted children's bacterial levels and dental caries.[21]

Mothers' dental knowledge, sense of fatalism about children's oral health, and self-efficacy can influence engagement in oral health-promoting behaviors and, in turn, caries risk. These cognitions are potentially modifiable and can be enhanced to motivate engagement in health-promoting and disease-preventing behaviors such as regular tooth-brushing for young children and appropriate bottle-feeding practices. Accurate assessment of caregivers' knowledge and perceptions about children's oral health can aid in the planning and implementation of tailored educational and cognitive-behavioral interventions. To date, however, there are no reliable and validated measures available to assess these cognitions.

The purpose of this paper was to present 4 new measures developed to assess African American mothers':

1. knowledge about children's oral hygiene needs;
2. knowledge about appropriate bottle use;
3. sense of fatalism;
4. level of self-efficacy related to brushing her young child's teeth regularly.

The measures were developed for a population-based sample of low-income African American mother-child dyads living in Detroit—a group that experiences a significant amount of dental disease. This paper also describes the reliability and validity of these newly developed measures and how they relate to the ECC status and brushing practices of children in this population.

Methods

Study design and sample

Data for this study are from the first phase (2002-2003) of a 7-year, longitudinal study being conducted by the Detroit Dental Health Project (DDHP). The DDHP is 1 of 5 centers funded by the National Institute of Dental and Craniofacial Research to reduce oral health disparities across the United States (NIDCR U-54 DE 14261).[23] The DDHP research program focuses on understanding the social, familial, biological, and neighborhood context of oral health among low-income African American families in Detroit. A multistage area probability sample design was used to select the population-based study sample of African American families. The authors selected the 39 poorest Census tracts in the city of Detroit based on 2000 Census data. Families were eligible if they had at least 1 child less than 6 years of age at baseline and were below 250% of federal poverty line. The final population-based study cohort included 1,021 children and their primary caregivers.

The procedures, possible discomforts or risks, and possible benefits were explained fully to the subjects involved, and their informed consent was obtained prior to the investigation. The research was reviewed and approved by the Health Sciences Institutional Review Board of the University of Michigan, Ann Arbor, Mich. Trained staff conducted face-to-face interviews with caregivers at the Dental Assessment Center in Detroit, Mich. Using a series of structured questionnaires, caregivers were surveyed about their beliefs, behaviors, diet, background, living conditions, and a wide array of psychosocial factors. All children and primary caregivers received a dental exam. The present study analyzed data from biological mothers of children ages 1 to 5 (N=749).

Questionnaire construction

The investigators constructed a questionnaire to measure a broad array of hypothesized determinants of children's oral health, including:

1. caregivers' knowledge, attitudes, and beliefs about children's oral health;
2. feelings of self-efficacy related to brushing at bedtime in the face of a variety of potential barriers;
3. the child's brushing habits;
4. caregiver's subjective perceptions of the child's oral health.

A total of 27 statements reflecting knowledge, attitudes, and beliefs about oral health were generated based on reviews of the pediatric and general dental literature. Item statements ranged from expectations about future oral health status and feelings of fatalism about dental caries to knowledge about how to care for children's teeth, baby

bottle use, and the process of developing caries. Caregivers were asked to express their level of agreement with each statement on a Likert scale (1=strongly disagree, 5=strongly agree). Several items were similar in content but framed differently, and not all items were included in the final scales.

A 9-item measure of oral health-related self-efficacy (OHSE) was adapted from a health promotion measure for exercise based on the transtheoretical model (TM). The TM is a widely used health behavior model that conceptualizes health behavior along a continuum of stages ranging from precontemplation through maintenance.[24-26] Only one other recently published efficacy instrument specifically measures caregivers' ability to care for several aspects of children's oral health needs, including toothbrushing. This instrument, however, was not available at the time the present study was undertaken.[17]

Children's 1-week brushing frequency was measured by their mothers' report of the total number of times the child's teeth were brushed in the last week by the child, caregiver, or someone else. The mother's perception of her child's oral health status was based on her answer to the following survey question: "How would you describe the condition of his/her (the child's) mouth and teeth? Would you say...excellent, very good, good, fair, or poor." The few "poor" responses were collapsed with the "fair" category.

Clinical examinations

Detailed examinations of each tooth surface were performed by a team of 4 dentists, although 2 performed the majority of the core examinations. The International Caries Detection and Assessment System (ICDAS) criteria for caries detection, developed by an expert panel during a series of workshops, are being used in the DDHP study. The dental team established reliable and consistent ratings based on this criteria system while following a specific examination protocol. All assessments were made visually on clean and dry teeth. The interrater reliability kappa coefficient was 0.83 overall, with 94% to 98% rater agreement. The intrarater reliability kappa coefficient was 0.74.[27] Each child was classified as either caries free, having ECC, or having severe ECC (S-ECC) based on the case definition proposed by an expert panel for research with preschool-age children.[28] This definition has been used in prior research[29] and was adopted by the American Academy of Pediatric Dentistry Council on Clinical Affairs in May 2000.[30]

Construction of scales

Some survey questions had a small number of missing values, usually less than 4% of all responses. Most missing values were imputed with imputation and variance estimation software (IVEware), except for brushing frequency variables. The brushing variables had inconsistencies in the responses, a higher frequency of missing values (about 10%), and complicated skip patterns, so they were not imputed. Imputation was done for individual items before calculating scores for scales. This process allowed for a more consistent sample size to be used in analyses. The final analyses were also adjusted with sample weights created to account for the study's design features. Specifically, the weight adjusts for the unequal probability of selection, participant nonresponse, and a poststratification control to make the sample representative of the population of children in Detroit in terms of race, gender, and age.

Exploratory factor analysis (EFA), using varimax rotation and item-total analyses, were used to inform the construction of scales from the 27 knowledge, belief, and attitude items and 9 efficacy items.[31] Validity was assessed by calculating each scale's reliability. The relationships between the scales and the dental outcomes (children's brushing frequency and oral health ratings) were examined. Pearson's correlation coefficients were computed to observe the association between 2 continuous variables, chi-square tests of association were used for 2 categorical variables, and analyses of variance (ANOVAs, including posthoc analyses) were used to assess the association between continuous and categorical variables. All analyses were conducted in SAS-callable SUDAAN version 8[32] statistical software to account for the complex sample design and produce robust variance estimations.

Results

The final sample included 719 cases with no missing data on the study variables. Nearly half (46%) of the mothers reported an annual household income of less than $10,000, with an average household size of 4, and 49% had not completed high school. Children in the study averaged 3.05 years, and 52% were females. Disease was highly prevalent: one third of the children had at least 1 cavitated carious lesion, and 55% were classified as having ECC or S-ECC. The age-adjusted prevalence of disease was even higher for the older children in the group, described in detail elsewhere.[33]

Children's teeth were brushed about 9 times per week either by the child or someone else (weighted mean=8.96, standard error [SE]=0.22), which is slightly more often than once every day. Although there was a wide range of responses (0 to 40), expected peaks at 7 times per week (once a day) and 14 times per week (twice a day) were observed. Brushing was not related to oral health ratings or disease severity, but the association between mothers' perceptions of her child's oral health and the disease severity measure was significant (chi-square=72.2; $P<.0000$). Furthermore, most of the 20% of children with fair/poor ratings had cavities. Among the ECC or S-ECC children, 72% had fair/poor oral health ratings, and 70% of children without any cavities had excellent ratings.

EFA results yielded 8 factors initially, of which only 4 suggested scales had acceptable reliabilities (Cronbach's alphas above 0.55). These 4 suggested scales reflected: (1) OHSE; (2) knowledge about appropriate bottle use

(KBU); (3) knowledge of children's oral hygiene needs (KCOH); and (4) oral health fatalism (OHF). Item-total analyses revealed the combination of items within each suggested scale that yielded the highest internal consistency of each scale. The composition of the final scales was determined by the combination of items suggested by the EFA and item-total analyses that yielded the highest Cronbach's alpha above 0.70, a commonly accepted standard of high internal consistency. Combinations of the 4 items identified by the EFA to constitute OHF, however, consistently yielded relatively low alphas.

The associations between the individual OHF items and dental outcomes were examined, and it was found that a single fatalism statement, "most children eventually develop dental cavities," seemed to best reflect this construct. The final KBU, KCOH, and OHSE scales and the OHF measure are summarized in Table 1. Items were averaged to compute a single scale score for KBU, KCOH, and OHSE.

The KBU, KCOH, and OHSE scales had high Cronbach's alphas (0.76, 0.77, and 0.91 respectively), indicative of good internal consistency reliability. Average scores on both KBU (4.00) and KCOH (4.51) were relatively high on the 1 to 5 scale and revealed that mothers were quite knowledgeable about appropriate bottle use practices and children's oral hygiene needs. Mothers' average OHSE was relatively high as well (2.99 on a 1 to 4 scale), indicating that most felt moderately confident about their ability to ensure their children's teeth were brushed at bedtime. Responses to the individual efficacy items were also positively skewed, and the most typical response was "moderately confident."

Relatively few mothers (less than 12%) reported "not being confident" about brushing their child's teeth in each situation. This response was most common in the situations where the mother was tired (12%), too busy (11%), or depressed (10%). Yet, despite being aware of preventive oral health behaviors and generally feeling efficacious about their children's brushing, the majority (568 out of 719, or 79%) of mothers endorsed a fatalistic oral health belief.

The 2 knowledge scales were correlated with one another (r=0.33; $P<.001$). KCOH was associated with OHF, such that mothers who endorsed a fatalistic belief had significantly lower scores on this scale, reflecting less knowledge of children's oral hygiene needs (4.45±0.04 vs 4.74±0.04; $P<.0001$). KBU was also related to OHF. Fatalistic mothers had lower scores than nonfatalistic mothers (3.92±0.06 vs 4.28±0.08; $P<.01$). OHSE was not significantly correlated with either knowledge scale or OHF.

Mothers' self-efficacy was positively correlated with children's brushing (r=0.18; $P<.0001$). Mothers who were more confident in their ability to make sure their child's teeth were brushed at bedtime were more likely to have children who brushed more frequently. Both knowledge scales were also significantly positively correlated with brushing frequency, but the magnitude of correlation was smaller. Children of fatalistic mothers brushed less often on average than children of nonfatalistic mothers (8.52±0.21 vs 10.59±0.62; $P<.01$).

OHSE and KCOH were each significantly positively associated with better oral health status perceptions in the bivariate analyses (Table 2). The relationship between KBU and the child's oral health rating followed this positive trend and approached standard statistical significance levels. When this relationship was examined separately for children ages 1 to 3, who are more likely than older children to be drinking regularly from bottles,

Table 1. Children's Oral Health Self-efficacy, Knowledge, and Fatalism Measures

Oral health self-efficacy (OHSE) scale: 4=very confident, 1=not at all confident
Under a lot of stress
Depressed
Anxious
Feeling like you don't have the time (too busy)
Tired
Worrying about other things in your life
Bothered by your crying child
Bothered because your child doesn't stay still when you want him or her to brush
Told by your child that he/she does not feel like brushing right now
Knowledge of bottle use (KBU) scale: 1=strongly agree, 5=strongly disagree
Putting a baby to bed with a bottle helps the child to be better fed.
Putting a baby to bed with a bottle helps the child sleep better.
Putting a baby to bed with a bottle helps the child to gain weight and grow.
There is nothing wrong with putting the baby to bed with a bottle.
Knowledge of children's oral hygiene (KCOH) scale: 1=strongly agree, 5=strongly disagree
Cavities in baby teeth don't matter, since they fall out anyway.
Keeping baby teeth clean is not very important; after all, they fall out.
There is not much I can do to stop my child from developing dental cavities.
There is not much I can do to help my child have healthy teeth.
Children don't need to brush every day until they get their permanent teeth.
Children don't really need their own toothbrush until all their teeth come in.
Oral health-related fatalism (OHF) scale: 5=strongly agree, 1=strongly disagree
Most children eventually develop dental cavities.

the relationship became stronger ($P<.01$). Fatalism was not associated with oral health status perceptions.

Although not associated with mothers' perceptions of children's oral health status, OHF was significantly associated with disease severity (chi-square=10.69; $P<.05$). Table 2 also shows the relationship between the other scales and disease severity. KCOH was significantly associated with the child's caries status. Mothers of S-ECC children had the lowest scores, reflecting less knowledge of this topic compared to mothers of children with ECC or who were caries free. The ECC group had a slightly higher average knowledge score than the caries free group, but the confidence intervals overlapped. Although KBU was not significantly associated with disease severity among all children, when 1- to 3-year-olds were examined separately the association became significant ($P<.05$).

Discussion

This study supports the reliability and validity of 4 newly developed measures designed to quickly assess dental-specific self-efficacy, fatalism, and knowledge in mothers of young African American children. The KBU, KCOH, OHF, and OHSE scales demonstrated feasibility and acceptability, given the low rate of missing data in this large study of lower-income African American families. This suggests that they can be readily administered and understood. The associations between these measures and children's dental practices and outcomes in this high-risk population are also noteworthy and indicative of the sensitivity of these instruments. While the majority of scores on the scales were positively skewed, the measures were able to detect significant variation.

Young children develop rapidly, and it is not surprising that KBU was more sensitive for mothers of infants and toddlers, but not preschoolers. This age group also has unique dental hygiene needs. KCOH was positively associated with all the dental practices and outcomes, reaffirming the utility of assessing knowledge in this area. It is unrealistic to expect mothers to conscientiously practice oral health-promoting behaviors without understanding that baby teeth are important, require care and cleaning, and can develop caries. Although the majority of mothers endorsed a fatalistic belief, given the burden of disease among children in the community, this perception could be the observed reality and, hence, be relatively stable. This could undermine oral health-promoting behaviors if not specifically addressed. Some research has found that lower-income populations often endorse fatalistic health beliefs, which may lower the effort they put forth in their self-care routines.[34]

Although the limitations of cross-sectional data must be kept in mind, if confirmed by further research, the brief measures presented here hold promise for the rapid and accurate assessment of maternal cognitions that influence oral health-promoting behaviors. Such cognitions are potentially modifiable, and can be enhanced through tailored educational and cognitive-behavioral interventions to lower caries risk.

Future research should also examine whether the associations reported here persist among a broader socioeconomic sample of African American families and among other racial/ethnic groups. Such replication can advance understanding of the broader determinants of children's oral health and inform interventions to promote it.

Conclusions

Based on this study's results, the following conclusions can be made:

1. This study provides evidence for the high internal consistency (reliability), validity, and feasibility of brief measures of oral health self-efficacy, fatalism, and knowledge designed for mothers of impoverished African American children ages 1 to 5.
2. These brief measures have demonstrated sensitivity and were found to be associated with children's brushing practices, oral health ratings, and disease outcomes in a population-based sample of low-income African Americans.
3. Further research with other population groups is required to assess the generalizability of these measures and their utility in intervention studies.

Table 2. Differences in Mother's Average Level of Self-efficacy and Hygiene and Bottle Use Knowledge Scores by Perception of Her Child's Oral Health and Early Childhood Caries (ECC or Severe-ECC) Status (Weighted Mean±SE)

Scale*	Fair/poor	Good	Very good	Excellent	*P* value
KBU	3.83±0.11	3.99±0.09	3.97±0.09	4.17±0.08	.0751
KCOH	4.37±0.07	4.45±0.08	4.64±0.05	4.58±0.04	.0453
OHSE	2.89±0.08	2.90±0.06	3.00±0.08	3.15±0.05	.0140
N (%)	160 (22)	193 (27)	175 (24)	191 (27)	
Scale*	**S-ECC**	**ECC**	**No caries**		***P* value**
KBU	3.90±0.10	3.99±0.08	4.05±0.05		.2727
KCOH	4.32±0.08	4.59±0.04	4.55±0.04		.0030
OHSE	2.94±0.09	3.05±0.06	2.97±0.04		.5364
N (%)	144 (25)	242 (33)	333 (45)		

*KBU=knowledge of bottle use; KCOH=knowledge of children's oral hygiene needs; OHSE=oral health self-efficacy.

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Abstract of the Scientific Literature

A Limited Review of Varicella-related Deaths, Pre- and Postvaccine

The childhood malady of chickenpox, or varicella, is generally not considered a serious disease, but in some cases it can lead to acute sickness and even death. In 1995, a varicella vaccine was licensed for distribution in the United States. The purpose of this study was to compare differences in deaths attributed to varicella between 1988 and 2000 in California, thus covering both a pre- and postvaccine period. An assessment of how certain complications and conditions added to the mortality rate was also considered. Cause of death files from the California Bureau of Vital Statistics were consulted from 1988 through 2000, and all records which indicated varicella as cause of death or underlying condition were selected. Prevaccine period death rates (1988 to 1995) were compared to postvaccine (1996 to 2000) rates, with the postvaccine period subdivided into an introductory (1996 to 1998) and impact period (1998 to 2000). Statistical analysis for the mortality rates was computed, with differences in age, ethnic groups, and gender identified. The number of deaths linked to varicella declined in the period following the introduction of the vaccine, with a significant decrease in the number of deaths seen in the impact period. Unfortunately, potentially preventable varicella-related deaths continue to occur.

Comments: Although this study is limited in scope by size as well as possible omission of varicella on a death certificate as an underlying factor, it is important to note that, as expected, the varicella vaccine is effective. We as dental practitioners should view the whole child, not just the mouth. In reviewing a health history, or during a consultation with a new patient, a query of all routine immunization records could easily be incorporated. Although not recommended for children less than 1 year of age or pregnant women, the varicella vaccine is another tool to help stop or decrease the severity of this disease. In speaking with the parents of our patients, we can further the cause of preventative health care by easily addressing the issue of proper immunizations and defer to our colleagues in the medical field for appropriate action. **GM**

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McCoy L, Sorvillo F, Simon P. Varicella-related mortality in California, 1988-2000. Pediatr Infect Dis J 2004;23:498-503.

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