

Tooth Brushing Behaviors and Fluoridated Toothpaste Use Among Children Younger Than Three Years Old in Chicago

David Avenetti, DDS, MSD, MPH¹

Oksana Pugach, MS, PhD³

Anna Sandoval, MPH⁵

Helen H. Lee, MD, MPH²

Genesis Rosales, MSW⁴

Molly Martin, MD, MAPP⁶

ABSTRACT

Purpose: To describe toothbrushing frequency/duration and toothpaste use among young children in an urban, vulnerable population in Chicago, Ill., USA.

Methods: Caregivers of children younger than three years old were recruited from university and community pediatric dental clinics. Caregivers completed a 37-item questionnaire in English or Spanish about predictors/covariates (demographics, child/caregiver oral health, access to dental care) and primary outcomes (child toothbrushing behaviors, toothpaste use). Models employed generalized logit and ordinal logistic regression.

Results: A total of 148 caregivers completed the survey. The average child age was 18.8 months (± 7.4 SD). Approximately 41 percent of children brushed once a day or less, and 19 percent of caregivers did not regularly assist. Almost all children used toothpaste (96 percent), but 36 percent of caregivers did not know if it contained fluoride. Increased child brushing frequency was associated with older child age, higher caregiver brushing frequency, history of a child dental visit, and caregiver assistance ($P < 0.05$). Children with a history of dental visits were seven times more likely to brush for 30 seconds or more, and receiving caregiver assistance was associated with brushing longer than two minutes ($P < 0.05$).

Conclusion: Most children brushed at least once daily and nearly all of them used toothpaste. Access to dental care, parental involvement, and parental oral health were associated with favorable child toothbrushing behaviors. Toothbrushing duration, frequency, and encouraging family assistance are modifiable protective factors and opportunities for intervention. (J Dent Child 2020;87(1):31-8)

Received September 12, 2019; Last Revision October 24, 2019; Accepted October 24, 2019.

KEYWORDS: PEDIATRIC DENTISTRY, PREVENTIVE DENTISTRY, TOOTHBRUSHING, ORAL HYGIENE, FLUORIDATION, HEALTH PROMOTION, INFANT ORAL HEALTH

¹Dr. Avenetti is a clinical associate professor and graduate program director, Department of Pediatric Dentistry, College of Dentistry; ²Dr. Lee is an assistant professor, Department of Anesthesiology; and ⁶Dr. Martin is an associate professor, Department of Pediatrics, both in the College of Medicine; ³Dr. Pugach is a biostatistician, Methodology Research Core, and Mses. ⁴Rosales and ⁵Sandoval are research specialists, all in the Institute for Health Research and Policy, all the University of Illinois at Chicago, Chicago, Ill., USA.

Correspond with Dr. Avenetti at avenetti@uic.edu

Despite expanded dental coverage for children in the United States under the Affordable Care Act, high rates of caries persist. Forty-three percent of children aged two to 19 years have experienced dental caries, and 13 percent have untreated dental caries.¹ Historically, caries disproportionately affects children from disadvantaged subgroups, including low-income

and select minority groups such as Hispanic and African-American populations.^{2,3} There are also disparities in dental care utilization, access to healthy food choices, food security, oral health literacy, and compliance with preventive behaviors.⁴⁻⁶ Caries is costly to society, but the cost of childhood caries goes beyond the cost of direct health care. That includes the social cost of pain, adverse effects on cognitive development, increased school absenteeism, increased caregiver absenteeism from work, and lower oral health-related quality of life.⁷

The Coordinated Oral Health Promotion (**CO-OP**) Chicago study was funded by the National Institute for Dental and Craniofacial Research as part of a consortium to develop and test interventions to reduce these oral health disparities in children. CO-OP Chicago first sought to establish baseline estimates of toothbrushing behaviors for children younger than three years old. Twice daily toothbrushing with fluoridated toothpaste is recommended as both a cost-effective and clinically effective means of reducing caries for all dentate children.⁸⁻¹⁰ However, insufficient data exist about the toothbrushing frequency and behaviors of children younger than three years old. Even the National Health and Nutritional Examination Survey (**NHANES**), the largest health survey conducted in the United States, does not report these behaviors in children under three years of age.¹¹

The purpose of this study was to describe the tooth brushing frequency, brushing duration, child brushing assistance, fluoridated toothpaste use, and quantity of toothpaste used gathered from a cross-sectional sample of children younger than three years old from vulnerable communities in Chicago. As a secondary aim, we explored associations between demographic factors and brushing behaviors. These data will inform subsequent interventions targeting caregivers and families of young children.

METHODS

This study was approved by the Institutional Review Board of the University of Illinois at Chicago (**UIC**), Chicago, Ill., USA (protocols 2015-0815 and 2016-0773). Surveys were conducted in two dental clinics between October 2016 and April 2017. The UIC pediatric dentistry clinic is an academic tertiary care center. It is the largest provider of dental care for Medicaid-enrolled children in Illinois, with over 21,000 patient visits annually. Ninety-seven percent of children are Medicaid eligible, and the patients are primarily Hispanic (57 percent) and black or African American (17.5 percent). The Infant Welfare Society of Chicago is a full-service federally qualified health center that sees more than 13,000 patients annually with a continuum of medical care, dental care, and other health services. Both clinics primarily serve the greater Chicago area and Cook County, Illinois.

Bilingual (English and Spanish) research assistants (**RAs**) recruited participants by approaching caregivers with children younger than three years old in the waiting areas of pediatric dental clinics. Subjects included children seeking an initial dental visit, recall visit, or treatment visit, or the sibling of a patient. Potential participants were screened, and verbal consent was obtained. Inclusion criteria were as follows: caregiver was at least 18 years old, spoke English or Spanish, had a dentate child under the age of three (by self-report), and lived with the child at least five days out of the week.

All questions were asked verbally in a semiprivate space in the waiting area of the clinics; data collection lasted five to 10 minutes. The survey consisted of 37 items related to demographics, child and caregiver oral health, child toothbrushing frequency and duration, toothpaste use, caregiver self-efficacy and support, dental access, and medical/dental insurance. A five-item oral health knowledge survey was included to establish oral health knowledge. Where possible, items were used from validated surveys. Data were inputted directly into a Surface Pro tablet using Qualtrics software (Provo, Utah, USA). Participants were given a \$5 gift card and toothbrushes after the survey was completed.

Descriptive statistics, including frequencies, means, and standard deviations, were calculated for all variables. Some response categories were collapsed if the distribution of responses was too sparse. The primary outcomes of interest (dependent variables) were: child brushing frequency (ordinal response with three categories: less than once a day, once a day, and twice or more a day); brushing duration (ordinal response with four categories: zero to 30 seconds, 30 to 60 seconds, 60 to 120 seconds, and more than 120 seconds); amount of toothpaste used when brushing (ordinal response with three categories: smear, pea, and half-load or more); and child use of fluoridated toothpaste (nominal responses: yes, no, unsure). A half-load of toothpaste is defined as covering half the surface of the toothbrush, and a full-load covers the entire toothbrush.

Multiple regression models were used to examine associations between select dependent variables and a predefined set of covariates. The final regression model for each primary outcome was determined using backward elimination. Specifically, analysis began with demographic constructs and retained covariates with *P*-values of <0.15. Insurance, oral health behaviors, and oral health knowledge variables were added and adhered to a *P*-value of 0.15 for individual variable retention in the model within each construct. Analysis used ordinal logistic regression for the child brushing frequency, amount of toothpaste, and child brushing duration outcomes, and generalized logistic regression for the fluoridated toothpaste outcome. The proportional odds assumption was satisfied for all cumulative logit models. Final model results are presented as odds ratios with 95 percent confidence intervals (**95% CI**). Variables with *P*-values

≤0.05 were reported as statistically significant. Analyses were performed using SAS 9.4 software (SAS Institute, Cary, N.C., USA).

RESULTS

From October 2016 to April 2017, 362 caregivers were approached for the survey. One hundred and four (29 percent) caregivers refused, 101 (28 percent) did not qualify or were excluded (three subjects were excluded from the analyses due to contradictory responses in the primary outcomes during validation), nine (two percent)

did not complete the surveys, and 148 (41 percent) were included for analysis. Ninety-six (65 percent) completed surveys originated from the UIC pediatric dental clinic, while 52 (35 percent) were from the community clinic. RAs spent a total of 248 hours recruiting participants.

Demographic characteristics of survey respondents and their children are described in Table 1. The type of child health insurance most commonly reported was public (54 percent), or the caregiver was unsure of the type of insurance (45 percent). Recent changes in Medicaid organization in Illinois resulted in a great deal of confusion among caregivers regarding the origin of their child's health insurance; "unsure" responses were likely public insurance based on the predominant insurance status of patients at the two study sites. Only 61 percent of caregivers had health insurance, and 41 percent of them reported that it covered dental treatment (Table 2).

Over 40 percent of caregivers reported a child brushing frequency of less than twice a day. Nineteen percent of caregivers reported someone helping the children brush only sometimes or not at all. There was considerable variation in toothbrushing duration, with 8.8 percent brushing for 30 seconds or less, 25.6 percent brushing 30 seconds to one minute, 35.8 percent brushing for one to two minutes, and 24.8 percent brushing for more than two minutes. Forty-two percent of caregivers reported that activities of daily life get in the way of brushing their children's teeth at least some of the time, and 26 percent have no family support with their child's toothbrushing. Toothpaste was used by 96.3 percent of the sample, with 50.4 percent indicating the toothpaste was fluoridated and 35.9 percent unsure of fluoride content. Approximately 55.7 percent of those who used toothpaste used a smear of toothpaste, while 32.8 percent used a pea-sized amount (Table 3).

Table 1. Survey Participant Demographics

Demographic characteristics	N=148 n (%)
Caregiver female*	128 (90.1)
Caregiver age in years† Mean±(SD)	30.9±6.8
Child female*	81 (57.0)
Child age in months† Mean±(SD)	18.8±7.4
Caregiver race‡	
White	13 (9.4)
Black	13 (9.4)
Asian	3 (2.2)
Mixed	1 (0.7)
Other	109 (78.4)
Caregiver Hispanic†	
Mexican	117 (83.6)
Puerto Rican	95 (81.2)
Other Hispanic	7 (6.0)
Refused to answer	15 (12.8)
Place of birth for Hispanic caregiver§	
U.S. Mainland	31 (26.5)
Mexico	72 (61.5)
Puerto Rico	2 (1.7)
Other	12 (10.3)
Caregiver education	
<High school	48 (34.0)
High school/General Education Diploma	61 (43.3)
Some college	15 (10.6)
≥College degree	17 (12.1)
Caregiver relationship status‡	
Single	38 (27.3)
Living with partner/married	99 (71.2)
Other	2 (1.4)
Number of adults live in home‡ Median (range)	2 (1-6)
Number of children who live in home‡ Median (range)	3 (1-7)
Employment status†	
Employed >32 hours/week	36 (25.7)
Employed <32 hours/week	17 (12.1)
Student	2 (1.4)
Homemaker	56 (40.0)
Retired	1 (0.7)
Unemployed	28 (20.0)

* N=142. † N=140. ‡ N=139. § N=117. || N=141.

Table 2. Caregiver and Child's Insurance Status

	Caregiver, N=148 n (%)	Child, N=148 n (%)
Health insurance type*		
Public	34 (24.3)	76 (53.9)
Private	14 (10.0)	2 (1.4)
Has insurance, not sure public or private	37 (26.4)	63 (44.7)
No insurance	55 (39.3)	0 (0.0)
Does health insurance cover dental care*		
Yes	64 (48.9)	130 (92.2)
No	59 (45.0)	4 (2.8)
Don't know	8 (6.1)	7 (5.0)
Is there separate dental insurance?*		
Yes	11 (7.9)	5 (3.6)
No	125 (89.9)	127 (90.1)
Don't know	3 (2.2)	9 (6.4)

* N<148 for some characteristics due to missing responses.

Nearly half of the children had been to the dentist in the last six months, but 44 percent had never been seen by a dentist despite most children being of age to have had their first dental visit and recruited in a dental

clinic waiting room (Table 4). Caregivers reported that 21 percent of children had experienced dental caries. Ninety-three percent of caregivers reported brushing their own teeth twice or more a day, 43 percent had not been to the dentist in the last year, and 55 percent described their oral health as fair or poor.

A five-item scale was used to score self-reported oral health knowledge based on correct responses to five oral health statements.¹² The average knowledge score was 4.4 out of a maximum of five (results not shown in tables). Items were scored as correct if they responded affirmatively that “cavities are caused by germs in the mouth” (79.7 percent correctly responded), “baby teeth are important” (85.3 percent), “children should go to the dentist regularly even when there is no problem” (92.3 percent), “it is best to use toothpaste with fluoride for children” (84.6 percent), and “children should stop using the bottle at one year old” (93.0 percent).

The regression models of associations between caregiver and child demographics and toothbrushing behaviors are shown in Table 5. Older children (odds ratio [OR] = 1.08, 95% CI = 1.02 to 1.15), children who had been to the dentist (OR = 2.87, 95% CI = 1.20-6.86), and caregivers who brush more frequently (OR = 2.23, 95% CI = 1.02 to 4.87) were more likely to brush their child’s teeth more frequently, while a higher report of activities interfering was associated with less brushing frequency (OR = 0.53, 95% CI = 0.02 to 0.43). Children who received caregiver assistance were more likely to brush twice a day compared to those who brushed less (OR = 2.18, 95% CI = 1.38 to 3.45). Privately insured caregivers compared to publicly insured (OR = 0.10, 95% CI = 0.02 to 0.43) and families where activities interfere with daily living (OR = 0.53, 95% CI = 0.38 to 0.75) reported less frequent child brushing.

Increased caregiver age (OR = 1.08, 95% CI = 1.03 to 1.14) and those with more family assistance with brushing (OR = 1.25, 95% CI = 1.02 to 1.55) had a higher brushing duration, whereas caregivers with better oral health (OR = 0.59, 95% CI = 0.39 to 0.90) reported lower child brushing duration. Children who had been to the dentist were 3.13 times as likely to brush for at least one minute (95% CI = 1.43 to 6.86) and 7.13 times as likely to brush for at least 30 seconds (95% CI = 2.12 to 24.03) compared to children who had not been to the dentist.

The correct amount of toothpaste was associated with higher caregiver brushing frequency (OR = 1.98, 95% CI = 1.00 to 3.91). Hispanics were less likely to use higher quantities of toothpaste compared to non-Hispanics (OR = 0.34, 95% CI = 0.14 to 0.84). Reported use of fluoridated toothpaste for younger children within the four- to 36-month age range of the sample was associated with higher caregiver oral health knowledge (OR = 3.19, 95% CI = 1.53 to

Table 3. Child Oral Health Behaviors According to Caregiver

Brushing	CO-OP Chicago Clinic survey N=148 N (%)	NHANES 2014, ages 3-5 years old N=449 N (%)
<i>Child brushing frequency (%)</i>		
Never	11 (7.4)	1 (0.3)
Sometimes but not every day	10 (6.8)	0 (0.0)
1x/day	39 (26.4)	164 (37.5)
2x/day	74 (50.0)	278 (54.3)
>2x/day	14 (9.5)	35 (7.9)
<i>Does parent or adult help child brush teeth?*</i>		
No	1 (0.7)	
Yes, sometimes	25 (18.3)	
Yes, most of the time	21 (15.3)	
Yes, always	90 (65.7)	
<i>How long are child's teeth brushed for?*</i>		
≤30 seconds	12 (8.8)	
>30-60 seconds	35 (25.6)	
>1-2 minutes	49 (35.8)	
>2 minutes	34 (24.8)	
Don't know	7 (5.1)	
<i>How often do activities of daily life get in the way of caring for a child's teeth?†</i>		
All of the time	11 (7.5)	
Most of the time	6 (4.1)	
Some of the time	44 (30.1)	
Rarely	17 (11.6)	
Never	68 (46.6)	
<i>How often does your family help you care for child's teeth?‡</i>		
All of the time	42 (28.8)	
Most of the time	16 (11.0)	
Some of the time	41 (28.1)	
Rarely	5 (3.4)	
Never	38 (26.0)	
Don't know	1 (0.7)	
Other	3 (2.1)	
<i>Does child use toothpaste?‡</i>		
Yes	131 (96.3)	
No	5 (3.7)	
<i>Does toothpaste have fluoride?§</i>		
Yes	66 (50.4)	
No	18 (13.7)	
Don't know	47 (35.9)	
<i>How much toothpaste does child use?§</i>		
Full load	3 (2.3)	80 (18.3)
Half load	12 (9.2)	75 (16.9)
Pea size	43 (32.8)	230 (52.2)
Smear	73 (55.7)	56 (12.6)

* N=137 for clinic survey.
‡ N=136 for clinic survey.

† N=146 for clinic survey.
§ N=131 for clinic survey.

6.68). However, when comparing the “yes” responses to the “unsure” responses for the use of fluoridated

toothpaste, caregivers were more likely to be confident (report “yes”) for older children (OR = 1.10, 95% CI = 1.03 to 1.18)—defined as closer to 36 months — and children who had already had dental caries (OR = 4.50, 95% CI equals 1.30 to 15.63). Caregivers with a greater length of time since their last dental visit were less likely to be sure about the use of fluoride toothpaste (OR equals 0.59, 95% CI equals 0.40 to 0.87).

Table 4. Child and Family Oral Health Risk Factors

	CO-OP Chicago Clinic survey N=148 N (%)	NHANES 2014, ages 3-5 years old N=449 N (%)
Child dental care utilization		
<i>When did child last go to dentist?*</i>		
≤6 months	72 (49.7)	278 (62.0)
6-12 months ago	6 (4.1)	58 (12.9)
1-2 years ago	2 (1.4)	13 (2.9)
Never has been	63 (43.5)	99 (22.0)
Don't know	2 (1.4)	0 (0.0)
Child access to fluoridated water		
<i>What kind of water does the child drink?†</i>		
Tap water	9 (6.3)	
Filtered water from tap	27 (18.9)	
Bottled water	105 (73.4)	
Other	2 (1.4)	
Child dental history		
<i>Has child ever had a cavity?‡</i>		
Yes	30 (21.0)	
No	104 (72.7)	
Don't know	9 (6.3)	
<i>Has child received anesthesia for dental care?‡</i>		
Yes	6 (4.2)	
No	137 (95.8)	
Caregiver/family risk factors		
<i>Caregiver brushing frequency‡</i>		
Never	0 (0.0)	0 (0.0)
Sometimes but not every day	0 (0.0)	0 (0.0)
1x/day	10 (7.1)	103 (30.7)
2x/day	98 (68.1)	198 (58.6)
>2x/day	35 (24.8)	36 (10.7)
<i>When did caregiver last go to dentist?‡</i>		
≤6 months	53 (37.6)	2,818 (46.2)
6-12 months ago	28 (19.9)	914 (15.0)
1-2 years ago	33 (23.4)	697 (11.4)
2-3 years ago	13 (9.2)	471 (7.7)
3-5 years ago	6 (4.3)	386 (6.3)
>5 years ago	5 (3.6)	775 (12.4)
Never has been	3 (2.1)	64 (1.05)
<i>Condition of caregiver's mouth and teeth (self-reported)‡</i>		
Very good	6 (4.3)	
Good	55 (39.0)	
Fair	53 (37.6)	
Poor	25 (17.7)	
Don't know	2 (1.4)	
<i>Have other children in the home received anesthesia for dental care?‡</i>		
Yes	27 (17.5)	
No	117 (81.8)	
Don't know	1 (0.7)	

* N=145. † N=143. ‡ N=141.

DISCUSSION

The purpose of this study was to establish baseline tooth-brushing behaviors in children younger than three years old in an urban and primarily Medicaid-enrolled population at high risk for developing caries. The data suggest that brushing frequency, duration, and caregiver assistance are opportunity areas for intervention. These behaviors are associated with caregiver reports of daily life stress and existing supports, as well as gaps in oral health knowledge. These data inform target areas for the subsequent behavioral trial that employs community health workers to address social challenges and oral health knowledge gaps in an urban population at high risk for childhood caries.

A high percentage of caregivers did not use fluoridated toothpaste or were unsure if the child's toothpaste contained fluoride. These results suggest that they were generally aware of recommendations surrounding tooth-brushing frequency but may not be clear about whether fluoridated toothpaste was appropriate for young children. The potential for inaccurate self-report of toothpaste used is a limitation of the study. Despite the universal recommendation for using fluoridated toothpaste in children, there remains wide variability in its adoption. Data from the Iowa Fluoride Study suggested that the use of fluoridated toothpaste in infants was low, with 58 percent not using fluoridated toothpaste at 12 months.^{13,14} Our participants reported comparably higher rates of fluoridated toothpaste use, and higher caregiver oral health knowledge was associated with the use of fluoridated toothpaste, again emphasizing the importance of knowing and applying recommendations. The large number of “unsure” responses may be driven by the mixed messages families receive from clinical and nonclinical sources. This confusion is made worse by product labeling, which suggests that parents may consult a dentist or physician for use in children less than two years of age. Confusion may also stem from marketing of non-fluoridated toothpaste to young children using product packaging, such as popular children's cartoon characters), product placement, and statements asserting “safe for babies”.¹⁵ This study is the first to report on tooth brushing behaviors in children younger than three years old since the American Dental Association changed its recommendation to use fluoridated toothpaste for all children. This variability highlights the need for educating caregivers about current guidelines and mitigating

Table 5. Association Between Demographics and Tooth Brushing Behavior

	Child brushing frequency* N=133 Odds ratio (95% CI)	Child brushing duration† N=126 Odds ratio (95% CI)	Amount of toothpaste‡ N=128 Odds ratio (95% CI)	Fluoridated toothpaste (Yes vs. No) N=120 Odds ratio (95% CI)	Fluoridated toothpaste (Yes vs. Unsure) N=120 Odds ratio (95% CI)
Caregiver Hispanic (reference: non-Hispanic)	N/A	N/A	0.34 (0.14-0.84) §	N/A	N/A
Caregiver age in years	N/A	1.08 (1.03-1.14)	N/A	N/A	N/A
Child age in months	1.08 (1.02-1.15) §	N/A	N/A	1.06 (0.97-1.16)	1.10 (1.03-1.18)
Caregiver health insurance		N/A	N/A	N/A	N/A
Public insurance	REF				
Not sure insurance type	1.26 (0.41-3.80)				
No insurance	1.00 (0.36-2.79)				
Private	0.10 (0.02-0.43)				
Activities interference	0.53 (0.38-0.75) ¶	0.80 (0.61-1.05)	N/A	N/A	N/A
Caregiver brushing frequency	2.23 (1.02-4.87) §	N/A	1.98 (1.00-3.91) §	N/A	N/A
Caregiver last dental visit (in years)	N/A	N/A	N/A	0.66 (0.41-1.08)	0.59 (0.40-0.87)
Child cavity or tooth decay (reference: no decay)	N/A	N/A	N/A	4.64 (0.77-28.05)	4.50 (1.30-15.63) §
Condition of caregiver's mouth and teeth#	N/A	0.59 (0.39-0.90) §	0.72 (0.47-1.11)	N/A	N/A
Assistance with brushing	2+ times vs. less: 2.18 (1.38-3.45) ¶### Once/day vs. less: 1.31 (0.99-1.73)	1.25 (1.02-1.55) §	N/A	N/A	N/A
Child has been to dentist (reference: never been to the dentist)	2.87 (1.20-6.86) §	>2 mins vs. less: 1.39 (0.58-3.37) ## >1 min vs. less: 3.13 (1.43-6.86) >30 secs. vs. less: 7.13 (2.12-24.03)	N/A	N/A	N/A
Oral health knowledge###	N/A	N/A	N/A	3.19 (1.53-6.68)	1.27 (0.69-2.35)

95% confidence interval [CI]).

* Outcome variable regressed as 3 ordinal categories: less than once a day, once a day, twice a day or more.

† Outcome variable regressed as 4 ordinal categories: 0-30 seconds, 30-60 seconds, 60-120 seconds, more than 2 minutes.

‡ Outcome variable regressed as 3 ordinal categories: pea, smear, half-load or more.

§ P<0.05. || P<0.01. ¶ P<0.001.

Poor/fair (reference) vs. good/very good. ## Effect of covariate changes with the point of dichotomization of ordinal outcome.

Higher score indicates more oral health knowledge.

fears about potential fluorosis and ingesting trace amounts of fluoride when brushing.

Findings from this study suggest that interventions aiming to increase brushing frequency, duration, and the universal use of fluoride use in children younger than three years of age must include an educational component targeted to the individual caregiver and the household. This finding is based on data showing that assistance with toothbrushing led to higher brushing frequency and duration. Our data indicate that oral knowledge was associated with the use of fluoridated toothpaste, suggesting that education may increase compliance.

However, oral health education should not be limited to education by a dental provider, as nearly 45 percent of the children had never seen a dentist. Brushing behaviors improved with age, which is not surprising, but it is unclear if brushing behaviors in very young children are hindered by child cooperation, lack of knowledge about brushing recommendations in children, or both. Other brushing outcomes were associated with family support and the home environment. This proposes a possible intervention opportunity through social support at the family level. Caregivers' interactions with the dental system and self-reported oral health conditions were

associated with child brushing habits, highlighting the important relationship between the oral health and behaviors of children and caregivers, which is consistent with previous research findings.¹⁶ Consequently, interventions aimed at the caregiver/family may have a positive effect on children by promoting healthy behaviors in the family unit.

In this study, all data were self-reported by caregivers. While self-reporting health behaviors are subject to bias, it is the most convenient and cost-effective method of collecting this data in the absence of validated objective measures. Nevertheless, our results follow comparable patterns to NHANES in three- to five-year-old children. NHANES data are presented in Table 3 to determine if the study sample differed from the general population regarding the few instrument items captured by NHANES. The distribution of responses in our sample was similar to NHANES, proving the generalizability of our findings, despite the limited geographic area of recruitment. The present study may over-report appropriate brushing behaviors because the survey was conducted in a dental care setting, potentially suggesting that families had more awareness of oral health issues and recommendations. Despite the sampling technique, a large portion of families was not aware of or achieved oral health recommendations. This is an opportunity to improve education and family support within the current dental system and among the general population who have not yet interacted with the dental system. The population from which the sample was drawn is an urban, vulnerable, predominantly Hispanic, Medicaid-insured children who were already seeking dental care, a primary demographic of interest for implementing interventions to reduce health disparities.

Compliance with toothbrushing recommendations and the use of fluoridated toothpaste can reduce caries.^{8,9} We observed that, in this vulnerable cohort of families with young children, many behaviors fit within oral care recommendations. However, opportunities to achieve greater adherence were also evident. Among young children, prevention efforts are primarily under the control of parents and healthy behaviors are established early in life. Initiating good toothbrushing behaviors early in life is a cost-effective approach to reduce the lifelong burden and cost of dental caries. Multilevel interventions are needed to promote culturally sensitive oral health behavior interventions that address individual, family, and community needs. Further population-level oral health data should be collected through examination and survey instruments such as NHANES about toothbrushing behaviors in children younger than three years old, including questions about whether toothpaste is used, if the toothpaste contains fluoride, brushing duration, and other oral health-promoting behaviors. Such data would be useful to for monitoring oral health behaviors and guiding future policy and interventions.

CONCLUSIONS

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

1. Most children younger than three years of age brushed at least once daily, and nearly all children used toothpaste. However, twice-daily brushing and use of the recommended amount of fluoridated toothpaste were less common.
2. Access to dental care, parental involvement, and parental oral health were associated with favorable child toothbrushing behaviors.
3. Toothbrushing duration, frequency, and encouraging family assistance are modifiable protective factors and opportunities for intervention based on the behaviors reported in this study.

ACKNOWLEDGMENTS

The authors wish to thank the members of the Chicago Steering Committee of Coordinated Oral Health Promotion (CO-OP) Chicago; the Community Advisory Board of the Coordinated Oral Health Promotion Chicago, which provided support and guidance; and the families, staff, providers, and administrators at the College of Dentistry Pediatric Dental Clinic, University of Illinois at Chicago, and the Infant Welfare Society of Chicago Pediatric Dental Clinic, all in Chicago, Ill. Dr. Lee's time was supported by the Foundation for Anesthesia Education and Research and the Anesthesia Quality Institute, Schaumburg, Ill. This research was supported by a grant from the National Institutes of Health, National Institute of Dental and Craniofacial Research (UH2DE025483), Bethesda, Md., USA.

REFERENCES

1. Fleming E, Afful J. Prevalence of total and untreated dental caries among youth: United States, 2015-2016. In: National Center for Health Statistics, ed. NCHS Data Brief. Vol. 37. Hyattsville, Md., USA: National Center for Health Statistics; 2018.
2. Mouradian WE, Wehr E, Crall JJ. Disparities in children's oral health and access to dental care. *JAMA* 2000;284(20):2625-31.
3. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in US children. *Pediatrics* 2008;121(2):e286-e298.
4. Edelstein BL. Disparities in oral health and access to care: Findings of national surveys. *Ambul Pediatr* 2002;2(2 suppl):141-7.
5. Schwendicke F, Dorfer CE, Schlattmann P, Page LF, Thomson WM, Paris S. Socioeconomic inequality and caries: A systematic review and meta-analysis. *J Dent Res* 2015;94(1):10-8.

References continued on the next page.

6. Horowitz AM, Kleinman DV. Oral health literacy: A pathway to reducing oral health disparities in Maryland. *J Public Health Dent* 2012;72(suppl 1): S26-S30.
7. Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E. Beyond the dmft: The human and economic cost of early childhood caries. *J Am Dent Assoc* 2009;140(6):650-7.
8. Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VCC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2010;1:CD007868.
9. Marinho VC. Cochrane reviews of randomized trials of fluoride therapies for preventing dental caries. *Eur Arch Paediatr Dent* 2009;10(3):183-91.
10. American Dental Association Council on Scientific Affairs. Fluoride toothpaste use for young children. *J Am Dent Assoc* 2014;145(2):190-1.
11. Johnson CL, Dohrmann SM, Burt VL, Mohadjer LK. National health and nutrition examination survey: Sample design, 2011-2014. *Vital Health Stat* 2014;162:1-33.
12. Wilson A, Brega AG, Batliner TS, Henderson W, Campagna E, Fehringer K, Gallegos J, Daniels D, Albino J. Assessment of parental oral health knowledge and behaviors among American Indians of a Northern Plains tribe. *J Public Health Dent* 2014; 74(2):159-67.
13. Levy SM, Kiritsy MC, Slager SL, Warren JJ, Kohout FJ. Patterns of fluoride dentifrice use among infants. *Pediatr Dent* 1997;19(1):50-5.
14. Franzman MR, Levy SM, Warren JJ, Broffitt B. Tooth-brushing and dentifrice use among children ages 6 to 60 months. *Pediatr Dent* 2004;26(1):87-92.
15. Basch CH, Rajan S. Marketing strategies and warning labels on children's toothpaste. *J Dent Hyg* 2014;88(5):316-9.
16. Dye BA, Vargas CM, Lee JJ, Magder L, Tinanoff N. Assessing the relationship between children's oral health status and that of their mothers. *J Am Dent Assoc* 2011;142(2):173-83.