Published in final edited form as:

J Public Health Dent. 2017 September ; 77(4): 350–359. doi:10.1111/jphd.12217.

Oral health beliefs, knowledge, and behaviors in Northern California American Indian and Alaska Native mothers regarding early childhood caries

Brenda Heaton, PhD, MPH^a, Andrew Crawford, PhD^b, Raul I. Garcia, DMD, MMedSc^a, Michelle Henshaw, DDS, MPH^a, Christine A. Riedy, PhD, MPH^c, Judith C. Barker, PhD^d, and Maureen A Wimsatt, PhD, MSW^b for the Native Oral Health Project

^aCenter for Research to Evaluate and Eliminate Dental Disparities (CREEDD), Boston University Henry M. Goldman School of Dental Medicine, Boston, Massachusetts

^bCalifornia Tribal Epidemiology Center, California Rural Indian Health Board, Inc., Sacramento, California

^cDepartment of Oral Health Policy and Epidemiology, Harvard School of Dental Medicine, Boston, Massachusetts

^dCenter to Address Disparities in Children's Oral Health (CAN DO), School of Dentistry, University of California San Francisco, San Francisco, California

Abstract

Objectives—To assess the oral health beliefs, knowledge, and behaviors related to early childhood caries (ECC) risk in a convenience sample of American Indian and Alaska Native (AIAN) mothers residing in rural Northern California communities.

Methods—Fifty-three mothers of young children were recruited from three tribal communities in Northern California with the assistance of the California Rural Indian Health Board, Inc. and its California Tribal Epidemiology Center and Dental Support Center. Trained study staff administered questionnaires to obtain basic sociodemographic information, to survey participants on their oral health beliefs, knowledge, and behaviors as related to ECC risk, and to identify possible barriers to their accessing professional oral health care. Analyses of covariance were used to explore associations between sociodemographic indicators and oral health behaviors, after controlling for knowledge, beliefs and barriers to care.

Results—Overall, 53% of participants reported their oral health as ‘fair’ or ‘poor’. Mothers’ education (high) and being employed were positively associated with better oral health behavior scores. Additionally, 72% of mothers reported having one or more barriers to oral health care including access. There was a significant relation ($p=.03$) between high number of reported barriers to oral health care and low oral health behavior scores.

Conclusions—Despite generally high-level oral health knowledge, perceptions of self and child oral health remains low in this sample of AIAN mothers. Factors identified as being associated

with oral health behaviors in this sample were similar to those found in other health disparities populations.

Keywords

Early Childhood Caries; oral health behaviors; Alaska Native; American Indian; oral health knowledge; oral health beliefs

Introduction

American Indians and Alaska Natives (AIAN) represent 2.6% of the US population(1). Nationwide, the AIAN population is more likely than the general population to be poor, unemployed, and to not have a college degree(2). Consequently, significant health disparities exist between the AIAN population and the general population. Methods to address these disparities in health and health care access through targeted intervention have been developed and tested for many conditions. However, intervention methods to address oral health disparities, specifically, have been minimal.

AIAN children are disproportionately burdened by dental caries(3). The 2014 Indian Health Service (IHS) Oral Health Survey revealed that the proportion of AIAN children ages 3 to 5 years old with untreated decay was more than three times higher than other US children (43% vs. 14%), based on estimates obtained from the 2009-2010 National Health and Nutrition Examination Survey (NHANES)(4). While caries prevalence in the US has declined over the past two decades, early childhood caries (ECC) prevalence has been persistently high in AIAN children nationally(5, 6). Additionally, the birth rate among AIAN women between the ages of 15-24 years is reportedly higher than that of the US general population of women in this age group, indicating an increasing population of young children at risk for dental disease(7).

Fourteen percent of all US AIAN live in California. According to the 2010 Census, California has more AIAN residents than any other state(1). Nearly 2% of California residents self-identify as AIAN, half of whom identify as AIAN only and the other half identify as AIAN in combination with one or more other races. Similar socioeconomic disparities exist in California, compared to the general population, along with the consequential health disparities(8). In particular, ECC prevalence in California among AIAN children in tribal communities and tribal Head Starts remains disproportionately high. The 2010 IHS Oral Health Survey of AIAN Preschool Children found that 8.5% of AIAN children 2 to 5 years old in California needed urgent dental care, the second-highest rate of all the IHS Areas studied.

Parental knowledge, beliefs, and behaviors about childhood dental health are generally recognized to influence oral health behaviors and to be important determinants of ECC (9, 10). However, there is a relative paucity of data from AIAN communities, and in particular from California, about the relations between AIAN mothers' oral health knowledge, beliefs, and ECC risk-related behaviors. Additionally, AIAN communities experience barriers to professional preventive and restorative oral health care for their children, often related to structural inadequacies(11) and financial or transportation concerns (12). There is an

extensive body of theory and research showing that health knowledge and beliefs predict behavior (13, 14) and thereby may play an important role in determining oral health status (15). The development of interventions to address gaps in knowledge or to minimize barriers, for example, rely on baseline information about the target population with respect to these factors. There is a need to develop effective ECC primary prevention approaches specific to AIAN families and communities. In turn, basic population-specific data about oral health care knowledge, beliefs, behaviors and barriers are needed in order to develop effective prevention programs tailored to diverse AIAN communities. Given the general lack of population-specific information on oral health-related knowledge, beliefs and behaviors among AIAN mothers, this study aimed to initially explore these domains.

The Native Oral Health Project (NOHP) was established to explore these population-specific, oral health indicators of AIAN mothers in Northern California. Specifically, the NOHP contains a set of exploratory studies into oral health beliefs, knowledge, and behaviors; potential barriers to oral health care access; and the acceptability and feasibility of community-engaged oral health interventions. The overarching goal of the NOHP work is to gain preliminary insight into possible predictors of oral health-related knowledge, beliefs and behaviors with the aim of suggesting potentially important areas for future observational study and intervention development. The present report reflects efforts to understand baseline levels of oral health knowledge, beliefs and behaviors and to explore the potential relationships among them for use in guiding future study. Our report is based on cross-sectional interview data collected from a convenience sample of AIAN mothers from three northern California tribal communities.

Methods

Recruitment

Recruitment of this population took a community-engaged research approach. Existing relationships with the California Dental Support Center, housed within the California Rural Indian Health Board, Inc. were leveraged for the California Tribal Epidemiology Center to gain access to three tribal communities in Northern California. Advisory board members and liaisons from the three tribal communities were engaged and assisted in facilitating the work of the NOHP. Specifically, a Community Advisory Board (CAB) composed of eight members from the AIAN community across California, including the three communities involved in this study, advised the NOHP. Recruitment methods were varied and included use of radio public service announcements, flyers, brochures, postcards, social media, and tribal liaisons' word-of-mouth communications with community organizations. Events were also held at a variety of tribal facilities and resource centers in each of the three communities during which AIAN mothers were invited to enjoy lunch, receive oral health giveaways (e.g. toothbrushes, fluoridated toothpaste, and dental floss), learn more about the project, and to sign up for the study, if interested. Women were eligible to participate if they self-identified as AIAN, were 18 years of age and were either pregnant or had a child aged 6 years or younger.

Oral Health Questionnaire

All participants completed a questionnaire regarding their oral health knowledge, behaviors, beliefs, and barriers to care, as well as basic socio-demographic information. This project used a modification of a survey instrument originally created by the National Institute of Dental and Craniofacial Research (NIDCR) Early Childhood Caries Collaborating Centers (EC4)(16) which was designed for use in caregiver populations with children aged 0 to 5. The survey incorporates constructs from several health behavior theories (14, 17-19) to explain the likelihood that individuals will engage (or do not engage) in positive oral health behaviors.

The paper-administered questionnaire, included 25 true/false questions about oral health knowledge and beliefs, 10 yes/no oral health behavior questions related to ECC disease and evaluated seven self-reported barriers to oral health care, including whether mothers and/or their child(ren) had access to insurance that covered dental care, such as California's Medicaid insurance, Medi-Cal. We also assessed which factors influenced women's ability to attend children's dental appointments. All questions were close-ended.

Data Analysis

Descriptive analyses were conducted on participant demographics and response frequencies of questionnaire items. Two scores were calculated by summing the total numbers of questionnaire items answered correctly for oral health knowledge/beliefs (possible score range = 0 to 25) and oral health behaviors (possible score range = 0 to 10). Questionnaire responses were determined to be "correct" based on the widely accepted professional recommendations for oral health care in pediatric populations, including recommendations made by the American Academy of Pediatric Dentistry(20). Correlation analyses and one-way analysis of variance (ANOVA) were conducted to examine bi-variate associations between demographic indicators and the calculated scores. An additional barrier index score was created to reflect the accumulated burden of reported barriers. A dichotomous cut-off point was established for each barrier based on the type of response scale used for the item. The cut-point for a dichotomous choice (e.g., Yes/No) barrier item was the relatively higher risk response (e.g., 'no dental insurance'). For a multi-point response scale (e.g., length of child's dental appointment measured in 15-minute intervals), the cut-point was the upper tertile of the scale based on a frequency analysis (e.g., longer dental appointment indicates barrier). The barrier index score was created by summing the number of barrier items for each respondent (range = 0 to 7) and was then used in models to examine associations with demographic indicators and oral health behaviors.

For demographic indicators that had a bi-variate relationship with oral health behaviors in the one-way ANOVAs ($p < .10$), a series of Analysis of Covariance (ANCOVA) tests were used to further assess associations between social demographic indicators and oral health behavior. Each ANCOVA used the average AIAN maternal oral health behaviors as the outcome variable and a maternal demographic indicator as a predictor variable in the model. Due to the small sample size available in the NOHP study and the resulting low statistical power, only one demographic indicator was included in the model at a time. Mothers'

positive oral health knowledge score and barriers to oral health care were entered as covariates in each ANCOVA.

The NOHP protocol received approval from the Institutional Review Board of the California Rural Indian Health Board, Inc.

Results

A convenience sample, comprised of 53 AIAN mothers aged 18 to 51 years old (median age = 29 years old) from three tribes in Northern California, completed the study questionnaire. Table 1 shows demographic characteristics of the sample, including comparative data for a subset of demographic variables on AIAN women in Northern California that were obtained from the 2011-2012 California Health Interview Survey (CHIS)(21). In comparison to available data from CHIS, the women in this study were more likely to have post-secondary education (58.5% vs. 41.1%, respectively), although fewer were employed (39.6% vs. 64.5%), either full- or part-time. Frequencies of annual household incomes below \$20k among women in the NOHP were similar to that of AIAN women in the comparable Northern California counties. Of the 53 women enrolled, approximately half reported their oral health as either 'fair' or 'poor', despite 71% reporting they had visited a dental clinic in the past year. Most of the women had dental insurance for themselves and their child and reported that their child had seen a dentist in the past year.

Questions related to oral health knowledge and beliefs and the related answer frequencies are presented in Table 2. Participants displayed high levels of oral health knowledge, with an average individual score of 88% answered correctly (range = 0.40 – 1.0). Knowledge-belief related items about the importance of baby teeth and whether or not soda/pop affects a child's teeth were answered correctly with the highest frequencies (Table 2; items 15 and 18). While it was not formally assessed whether participants were familiar with the concept of fluoride varnish, the knowledge-belief related item about how often fluoride varnish should be applied to children's teeth was answered correctly with the lowest frequency (Table 2; item 11).

Questions related to oral health behaviors and the related answer frequencies are presented in Table 3. A total of 10 ECC risk-reducing behaviors were assessed. On average, mothers reported engaging in half of these behaviors, with individual reports ranging from 1 to 7. Mothers most frequently reported that their children regularly attended routine dental checkups or cleanings (Table 3; item 1). Mothers reported brushing/wiping their child's teeth/gums just before bed with the lowest frequency, followed by reports of at least two applications of fluoride varnish on their child's teeth during the past year (Table 3; items 6 and 9).

The barriers to care (Table 4) most frequently identified were those that reflected demands on time, including time spent attending children's dental appointments (38.5%). Of participants who were employed (N=18), 55.7% reported that they missed work one or more times to take their children to the clinic for a dental appointment during the past year. In general, mode of transportation (13.2%), time of travel to the appointment (9.4%), and

insurance status for the child (1.9%) or themselves (3.8%) did not appear to be barriers for the majority of mothers in the study. A total of 11.3% reported that there was a time they could not get dental care when they needed it during the past 12 months. Overall, we found that 72% reported experiencing at least one barrier to oral health care and 42% experienced two or more barriers (range = 0 to 4).

Results of the zero-order correlation analyses indicated that higher education status was significantly correlated with oral health knowledge and beliefs ($r = .296, p = .04$) and reports of positive oral health behaviors ($r = .299, p = .03$). Employment status (being employed) was also associated with positive oral health behaviors ($r = .278, p = .05$). The correlation of median income was not statistically significant with positive oral health behaviors ($r = .165, p = .26$) or knowledge and beliefs ($r = .195, p = .18$), although median income was positively associated with education status ($r = .277, p = .05$). When considering the relationships among oral health indicators, knowledge and beliefs were positively correlated with behaviors ($r = .325, p = .02$).

The bi-variate relation of each demographic indicator with positive oral health behaviors was assessed further with bi-variate tests using one-way analysis of variance (ANOVA). The one-way ANOVA results are presented in Table 5 and indicated that education and employment status were significantly related to positive oral health behaviors ($p = .03$ and $.05$, respectively), relationship status was marginally related ($p = .07$), and median income was in the expected direction but not statistically significant ($p = .26$). The three demographic indicators (education, employment, and relationship status) with the strongest bi-variate association with positive oral health behaviors were then included analysis of covariance (ANCOVA) to assess the relation of each with positive oral health behaviors after controlling for mother's oral health knowledge and number of barriers to care. Due to small sample size and resulting low statistical power, a separate ANCOVA was conducted for each demographic indicator.

Table 6 shows the ANCOVA results when education status was included as the independent variable in the model and number of barriers and mother's oral health knowledge and beliefs entered as covariates. Mothers with higher education had a higher mean score for positive oral health behaviors. There was a statistically significant relationship between number of barriers to oral health care and average number of positive oral health behaviors ($F = 5.35, p = .03$), which indicated that mothers with a higher number of barriers and higher oral health knowledge scores had a higher mean score for positive oral health behaviors. In sum, mothers' higher education status was found to be associated with higher average positive oral health behaviors after accounting for mothers' oral health knowledge and beliefs and mothers' barriers to oral health care. Additional ANCOVAs using employment status and relationship status as indicators did not find significant associations with average oral health behaviors after controlling for oral health knowledge and beliefs and barriers to oral health care.

Discussion

Findings from this convenience sample suggest that oral health-related knowledge, beliefs and barriers may play a role in oral health behaviors, after accounting for various demographic indicators. Over half of the participants (53%) reported their oral health as 'fair' or 'poor' and 72% reported having one or more barriers to oral health care. Mothers' education (high) and being employed were positively associated with better oral health behavior scores. There was a significant relationship ($p=0.03$) between high number of reported barriers to oral health care and low oral health behavior scores. Despite generally high-level oral health knowledge, perceptions of self and child oral health remain low in this sample of AIAN mothers. Importantly, the factors that we identified as being associated with oral health behaviors in this sample of AIAN caregivers were similar to those found in other health disparities populations.

Findings from this sample of Northern California AIAN mothers are reflective of the extensive body of theory and research showing that parental knowledge, attitudes, and beliefs influence oral health behaviors (13, 14).. Parents have varying knowledge of caries etiology and risk, and their beliefs and attitudes are in part dependent on their culture and heritage. Data on the relationship between knowledge and beliefs as related to dental care behaviors among AIANs are limited. Findings add to our knowledge base on the extent to which AIAN parents face obstacles that may decrease compliance with professionally-provided preventive practices and also may limit access to preventive and restorative care for their children. Several potential barriers to oral health care were assessed in the NOHP. Some of the most commonly reported barriers involved the time spent traveling to appointments, the time spent attending children's dental appointments, and the need for employed mothers to take time off from their jobs. In general, neither insurance nor transportation issues appeared to be significant barriers to most mothers in the study. The absence of a transportation barrier in the NOHP contradicts other research(12) which indicates traveling long distances in rural areas to get to dental clinics is a major barrier that limits AIAN access to needed oral health care. The reasons for this are unclear but could be due to any one or combination of factors such as greater access to transportation, less difficult terrain and/or weather, etc. The absence of insurance and transportation barriers in the NOHP may be due in part to the relatively high education status of participants in this convenience sample compared to AIAN women in Northern California rural counties(21). In addition, some participants in this relatively small sample may not live in the most far-removed rural areas.

Various socio-demographic factors may also influence parents' oral health behaviors. For example, being employed (22) and being in a relationship (23) were associated with positive oral health behaviors. Similarly, mothers in the NOHP who had attended college or attained a college or graduate degree reported engaging in more positive oral health behaviors. This is consistent with prior research which showed that higher education status has been associated with positive oral health behaviors(24, 25). This finding also reflects the wider value of higher education of tribal members(26) and suggests that policymakers continue to advocate generally for advanced educational opportunities for AIAN people(27). Although health education for parents and caregivers is recommended(28, 29), it has generally not

been shown to be effective, by itself, in reducing caries(30, 31). Such factors underscore the need for developing culturally-sensitive, targeted interventions in AIAN groups.

Recent research demonstrated the relation among caregiver/child health status, caries status, and positive oral health knowledge and behaviors(32). Caregivers with three- to five-year-old children enrolled in a Navajo Nation Head Start Center completed questionnaires at enrollment with concomitant evaluation of children for decayed, missing, and filled tooth surfaces (dmfs). Oral health knowledge and behavior outcomes were compared with convergent measures (participant sociodemographic characteristics, oral health attitudes, and indicators of oral health status). They found that caregivers' oral health knowledge was significantly associated with education, income, and oral health behaviors. Behaviors were significantly associated with several measures of oral health attitudes and all but one measure of oral health status. As the caregivers' oral health behaviors score improved, their children's dmfs scores declined, child/caregiver overall oral health status improved, and pediatric oral health quality of life improved(32).

We found that, on average, the AIAN mothers in the NOHP sample reported more correct responses to survey items about oral health knowledge and beliefs than to items about beneficial oral health behaviors. Although results were in line with the empirical framework for the study and suggest a positive association between oral health knowledge and beliefs and oral health behaviors, the discrepancy between correct answers may warrant exploration in future research. Many health interventions are based on an education model aimed at improving oral health knowledge and beliefs in hopes that oral health behaviors will also improve. In the case of AIAN mothers, it may be that interventions will be most effective if they target oral health knowledge and beliefs *and also* focus on making improvements in specific oral health behaviors, i.e. skill-building. For example, with the NOHP study sample, interventions could be tailored to improve oral health knowledge and beliefs and also to work directly with mothers specifically to record and reduce the numbers of times children eat or drink something other than water after brushing teeth or wiping gums before going to sleep and teaching parents to assist with and correctly brush their children's teeth. Another behavior-focused intervention approach for mothers in the NOHP study could involve working with mothers to identify opportunities for fluoride varnish applications for children and to facilitate scheduling or utilization of available services, including dental appointments for children. Future research about discrepancies between reported correct, or beneficial, oral health knowledge and beliefs and oral health behaviors among AIAN mothers would also inform prevention and intervention practices. This additional knowledge would be especially useful for medical and dental practitioners to shape clinic-based health education initiatives, as well as be available for use by non-clinicians working in relevant non-clinical, social services settings (e.g. WIC programs, HeadStart, etc.) for their educational efforts.

There are additional avenues for future research based on the findings from this baseline data on AIAN mothers in the NOHP study. An important limitation of our work is the small sample size and the extent to which our convenience sample may, or may not, be representative of other AIAN mothers in Northern California, or elsewhere. In addition to increasing the sample size and drawing a representative population sample involving more tribal groups and other recognized AIAN entities, future work could more closely examine

whether demographic indicators and/or oral health knowledge and beliefs interact to influence oral health behaviors for AIAN mothers. For example, in our sub-group analyses, we observed that single, employed mothers reported the lowest level of positive oral health behaviors. While this finding was not statistically significant ($p = 0.7$), it may merit further exploration in a larger study, as it may be advantageous to target interventions to those particular groups that could gain the most benefit. Finally, in future research, it will be important to examine longitudinal relations between demographic indicators, oral health knowledge and beliefs, oral health behaviors, and barriers to oral health care for AIAN mothers.

Our findings indicate that knowledge alone may not be effective in promoting positive oral health behaviors and predicting oral health status in AIAN caregivers. This is in agreement with the results recently reported by a major randomized controlled trial on caries prevention in AIAN children (33). In addition to more thorough investigations into the relationships among oral health knowledge, beliefs and behaviors, future research in AIAN populations needs to include investigation into the perceived value of oral health as a potential mechanism in the translation of knowledge into practice(34). Effective oral health promotion strategies in AIAN communities will likely require a multi-pronged approach that includes providing culturally appropriate community outreach and community-engaged education to prevent ECC; making linkages between pediatric primary medical care and dental care; and developing and funding programs specifically designed for improving oral health and reducing multiple levels of barriers to dental care access for AIAN mothers and children. Strategic health policies are needed to support oral health research, prevention, and intervention initiatives and to coordinate care between primary care physicians, dentists, and other early childhood education and healthcare providers in AIAN communities.

Acknowledgments

The Native Oral Health Project (NOHP) study team is grateful to the American Indian and Alaska Native (AIAN) mothers who completed the baseline survey for this project.

This project described was supported by the National Institute of Dental and Craniofacial Research (NIDCR), National Institutes of Health, award number R21 DE021573. The BRFQ instrument used for data collection in this work was developed by the NIDCR Early Childhood Caries Collaborating Centers, known as EC4, through cooperative agreements with Boston Univ. (U54 DE019275), Univ. California San Francisco (U54 DE 019285), and Univ. Colorado Denver (U54 DE019259), from the National Institute of Dental and Craniofacial Research, National Institutes of Health. The content was solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Dental and Craniofacial Research of the National Institutes of Health.

We thank the current or former members of the California Tribal Epidemiology Center, California Dental Support Center, and parent organization California Rural Indian Health Board, Inc. for their significant contributions to various stages of NOHP. We thank the NOHP Community Advisory Board for their advice on recruitment, study procedures, and ways to engage effectively with tribal communities. We also thank Jane Weintraub, DDS, MPH, formerly at University California San Francisco, for her advice during the project planning phase. Lastly, we thank Ruth Nowjack-Raymer, PhD, MPH, former Program Official and Director of the Health Disparities Research Program, Center for Clinical Research, at the National Institute of Dental and Craniofacial Research, for her advice and encouragement.

References

1. The American Indian and Alaska Native Population: 2010. U.S. Census Bureau; 2012. Contract No.: C2010BR-10

2. Castor ML, Smyser MS, Taulii MM, Park AN, Lawson SA, Forquera RA. A nationwide population-based study identifying health disparities between American Indians/Alaska natives and the general populations living in select urban counties. *Am J Public Health*. 2006; 96(8):1478–84. [PubMed: 16571711]
3. The 1999 oral health survey of American Indian and Alaska Native dental patients: Findings, regional differences, and national comparisons. Washington, D.C.: Indian Health Service; 2002.
4. Phipps KR. Improving the Oral Health of American Indians and Alaska Natives. *Current Oral Health Reports*. 2016; 3(3):1790186. Epub 03 June 2016.
5. Dye BA, Tan S, Smith V, Lewis BG, Barker LK, Thornton-Evans G, et al. Trends in oral health status: United States, 1988-1994 and 1999-2004. *Vital and health statistics Series 11, Data from the national health survey*. 2007; (248):1–92. Epub 2007/07/19.
6. Dye BA, Thornton-Evans G, Li X, Iafolla TJ. Dental caries and sealant prevalence in children and adolescents in the United States, 2011-2012. *NCHS data brief*. 2015; (191):1–8. Epub 2015/05/02.
7. Devoe F, Darling-Churchill K. Status and Trends in the Education of American Indians and Alaska Natives. National Center for Education Statistics. 2008
8. U.S. Census Bureau. 2010 American Community Survey. American FactFinder. Available from: <http://factfinder2.census.gov>
9. Garcia R, Borrelli B, Dhar V, Douglass J, Gomez FR, Hieftje K, et al. Progress in Early Childhood Caries and Opportunities in Research, Policy, and Clinical Management. *Pediatr Dent*. 2015; 37(3): 294–9. Epub 2015/06/13. [PubMed: 26063559]
10. Ismail AI. Prevention of early childhood caries. *Community Dent Oral*. 1998; 26(1 Suppl):49–61. Epub 1998/07/22.
11. Broken promises: Evaluating the Native American health care system. U.S. Commission on Civil Rights. Sep.2004
12. Korenbrot C, Kao C, Crouch JA. Funding of Tribal Health Programs Linked to Lower Rates of Hospitalization for Conditions Sensitive to Ambulatory Care. *Med Care*. 2009; 47(1):88–96. [PubMed: 19106736]
13. Ajzen I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *J Appl Soc Psychol*. 2002; 32(4):665–83.
14. Ajzen I. The Theory of Planned Behavior. *Organ Behav Hum Dec*. 1991; 50(2):179–211.
15. Pine CM, Adair PM, Nicoll AD, Burnside G, Petersen PE, Beighton D, et al. International comparisons of health inequalities in childhood dental caries. *Community Dent Health*. 2004; 21(1 Suppl):121–30. Epub 2004/04/10. [PubMed: 15072481]
16. Early Childhood Caries Collaborating Centers (EC4). [cited 2016 08/08/2016]; Available from: <https://oralhealthdisparities.ucsf.edu>
17. Bandura A. Self-Efficacy - toward a Unifying Theory of Behavioral Change. *Psychol Rev*. 1977; 84(2):191–215. [PubMed: 847061]
18. Tedesco LA, Keffer MA, Fleckkandath C. Self-Efficacy, Reasoned Action, and Oral Health Behavior Reports - a Social Cognitive Approach to Compliance. *J Behav Med*. 1991; 14(4):341–55. [PubMed: 1942013]
19. Stretcher, V., Rosenstock, IM. The Health Belief Model. In: Glanz, K.Lewis, FM., Rimer, BK., editors. *Health Behaviour and Health Education: Theory, Research and Practice*. San Francisco: Jossey-Bass; 1997.
20. American Academy of Pediatric Dentistry, Council on Clinical Affairs. Policy on Early Childhood Caries (ECC): Classification, Consequences, and Preventive Strategies. Reference Manual. 2016 Feb 27.38:52–4. [Internet]. 2017. Available from: http://www.aapd.org/media/Policies_Guidelines/P_ECCClassifications1.pdf.
21. California Health Interview Survey. UCLA Center for Health Policy Research. [database on the Internet][cited 08/08/2016]. Available from: <ask.chis.ucla.edu>
22. Green BL, Person S, Crowther M, Frison S, Shipp M, Lee P, et al. Demographic and geographic variations of oral health among African Americans based on NHANES III. *Community Dent Health*. 2003; 20(2):117–22. Epub 2003/06/28. [PubMed: 12828273]
23. McGrath C, Yeung CY, Bedi R. Are single mothers in Britain failing to monitor their oral health? *Postgrad Med J*. 2002; 78(918):229–32. Epub 2002/04/04. [PubMed: 11930026]

24. Paulander J, Axelsson P, Lindhe J. Association between level of education and oral health status in 35-, 50-, 65- and 75-year-olds. *J Clin Perio*. 2003; 30(8):697–704. Epub 2003/07/31.
25. Schmoeckel J, Santamaria RM, Splieth CH. Long-term caries development in schoolchildren and the role of educational status. *Quintessence Int*. 2015; 46(5):409–15. [PubMed: 25646171]
26. Harder+Company Community Research. Cultivating success: The critical value of American Indian scholarships and the positive impact of tribal college capital. San Diego, CA: American Indian College Fund; 2003.
27. Harder+Company Community Research. Fostering success: Need and resiliency among Tribal college students. San Diego, CA: American Indian College Fund; 2012.
28. Guideline on periodicity of examination, preventive dental services, anticipatory guidance/ counseling, and oral treatment for infants, children, and adolescents. *Pediatr Dent*. 2008; 30(7 Suppl):112–8. Epub 2009/02/17. [PubMed: 19216408]
29. The IHS Dental Explorer. Indian Health Service Division of Oral Health. Feb.2010
30. Benitez C, O'Sullivan D, Tinanoff N. Effect of a preventive approach for the treatment of nursing bottle caries. *ASDC J Dent Child*. 1994; 61(1):46–9. Epub 1994/01/01. [PubMed: 8182198]
31. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral*. 1996; 24(4):231–5.
32. Wilson AR, Brega AG, Campagna EJ, Braun PA, Henderson WG, Bryant LL, et al. Validation and Impact of Caregivers' Oral Health Knowledge and Behavior on Children's Oral Health Status. *Pediatr Dent*. 2016; 38(1):47–54. Epub 2016/02/20.
33. Braun PA, Quissell DO, Henderson WG, Bryant LL, Gregorich SE, George C, et al. A Cluster-Randomized, Community-Based, Tribally Delivered Oral Health Promotion Trial in Navajo Head Start Children. *J Dent Res*. 2016; 95(11):1237–44. Epub 2016/07/22. [PubMed: 27439724]
34. Fishbein M, Yzer MC. Using theory to design effective health behavior interventions. *Commun Theor*. 2003; 13(2):164–83.

Table 1
Characteristics of study participants with California Health Interview Survey (CHIS)
comparisons

	NOHP Participants (N = 53) %	CHIS ^I (N~14,500) %
Education		
12th grade education or completed GED	39.6	60.8
At least some college	58.5	41.1
Employment Status		
Employed full or part-time	39.6	64.5
Unemployed (includes students, homemaker, disabled)	54.8	35.1
Annual Household Income \$20,000	47.2	46.4
Relationship Status		
Married or living with partner	58.5	48.2
Divorced, separated, or never married	35.8	51.8
Age of participating mothers (quartile)		
18 - 23 years	25.0	
24 - 29 years	32.7	
30 - 34 years	21.1	
35 - 51 years	21.2	
Overall Oral Health Rating for Self		
Fair or poor	52.8	
Overall Oral Health Rating for Child		
Fair or poor	18.9	
Adult Dental Insurance		
Yes	84.9	
Child Dental Insurance		
Yes	84.9	
Time Since Mother's Last Dental Visit		
Within the past year (1-12 months)	71.2	
Time Since Child's Last Routine Checkup or Cleaning		
Within past year	85.7	
More than 1 year ago but less than 2 years ago	11.3	
Unmet child dental needs in prior year		
Yes	11.3	

Note: One or more response categories for each variable among NOHP participants were statistically unstable due to restricted sample size

^IData for 2011 and 2012 were pooled estimates (N~14,500 is the mean of estimated Ns over the two years--an estimated N shown here as an approximation); UCLA Center for Health Policy Research. AskCHIS 2011-2012. Data for adult AIAN females (Northern California/Sierra Counties) – Education level; Current employment status; Annual household income; Marital status. Available at <http://ask.chis.ucla.edu>. Exported on June 2, 2016.

Table 2
Survey responses regarding mothers' knowledge and beliefs about childhood oral health

	Responses (N=53) %
Cleaning a pacifier in your own mouth after it has fallen on the floor and giving to baby spreads cavity germs. (Yes)	86.8
Sharing food from the same spoon with family members spreads cavity germs. (Yes)	81.1
Sharing food from the same spoon with a friend spreads cavity germs. (Yes)	84.9
Sharing a toothbrush with a family member spreads cavity germs. (Yes)	90.6
Sharing a toothbrush with a friend spreads cavity germs. (Yes)	88.7
Kissing a baby on the cheek spreads cavity germs. (No)	84.9
At what age should a child first have his/her teeth checked by a dentist or doctor? (less than 1 year old or 1 year old).	84.9
On average, about how many times a year should a child see someone for dental care? (two or more times)	71.7
How many times a day should a child's teeth be brushed? (two or more times)	94.4
If a child has no teeth, how many times a day should gums be wiped? (two or more times)	79.2
In one year, how many times should fluoride varnish be applied to a child's teeth? (Two or more times)	47.2
Cavities are caused by germs in the mouth. (True)	67.9
It is best to use toothpaste with fluoride when brushing a child's teeth. (True)	64.2
Going to bed with a sippy cup or bottle with anything in it but water can hurt a child's teeth. (True)	94.3
Because they do not stay in your child's mouth very long, baby teeth are not that important. (False)	96.2
There is no need to go to the dentist unless children have a problem with their teeth. (False)	94.3
Eating something after brushing teeth but before going to bed affects child's teeth. (Bad)	88.7
Drinking soda or pop affects child's teeth. (Bad)	96.2
Eating sweet or sugary foods affects a child's teeth. (Bad)	94.3
Sharing a toothbrush with your child affects child's teeth. (Bad)	88.7
Using same spoon to taste the food and feed the child. (Bad)	81.1
Drinking milk from a sippy cup affects child's teeth. (Bad)	86.8
Getting fluoride varnish put on child's teeth affects child's teeth. (Good)	77.4
Brushing your own teeth affects child's teeth. (Good)	60.4
Brushing child's teeth or wiping gums (if child has no teeth) affects child's teeth. (Good)	94.3

Note. Percentages reported for mothers' correct responses only (correct item response in parentheses). A total of six survey items required mothers to provide "yes/no" responses; four survey items required mothers to select multiple choice responses associated with number of times per year/day; five survey items required mothers to provide "true/false" responses; and nine survey items required mothers to provide "good/bad/does not affect" responses.

Table 3
Self-reported behaviors related to childhood oral health

	Responses (N=53) %
During the past year, has your child been to a dentist or dental clinic for a routine checkup or cleaning? (yes)	64.2
How often are your child's teeth and gums brushed or wiped? (twice or more per day)	47.2
When your child's teeth are brushed, is fluoride toothpaste usually used? (yes)	52.8
How often does your child eat sweet or sugary foods? (rarely/never or at least once per week but not every day)	54.7
How often does your child drink sweet or sugary drinks? (rarely/never or at least once per week but not every day)	58.5
In past week, how often did your child eat or drink something other than water after brushing teeth/wiping gums and before going to sleep? (0 times)	28.3
How often does your child put anything in his/her mouth that has just been in someone else's mouth? (Never)	34.0
During the past year, has your child had fluoride varnish put on his/her teeth? (Yes)	56.6
If your child has had fluoride varnish put on his/her teeth, how many times during the past year has your child had fluoride varnish applied? (two or more times)	30.2
How often do you brush your own teeth? (twice or more per day)	52.8

Note: Percentages reported for mothers' correct responses only (correct item response in parentheses). A total of three survey items required mothers to provide "yes/no" responses; six survey items required mothers to select multiple choice responses associated with number of times per year/week/day; and one survey item required mothers to answer multiple choice responses associated with the general frequency of an oral health behavior.

Table 4
Self-reported barriers to oral health care

	Responses (N=53) %
1. Do you now have any type of insurance that pays for all or part of your child's dental health care?	
Yes	84.9
No *	1.9
Unknown or no response	13.2
2. Do you now have dental insurance for yourself?	
Yes	84.9
No *	3.8
Unknown or no response	11.3
3. During the past 12 months, was there a time when your child needed dental care, but you couldn't get it at the time?	
Yes *	11.3
No	75.5
Unknown or no response	13.2
4. How long does a dental visit usually take from the time you arrive until the time you leave?	
30 minutes	43.4
> 30 minutes *	35.8
Unknown or no response	20.8
5. During the past year, how many times did you miss work to take your child for dental care?	
Never missed	44.4
1 time *	55.7 ^I
6. How much time does it (or would it) take you and your child to travel to the dental office or clinic?	
30 minutes	79.4
> 30 minutes *	9.4
Unknown or no response	11.3
7. How do you get to the dental office or clinic?	
Drive	77.4
Public transit or would be driven by another person *	13.2
Unknown or no response	9.4

* Indicates response category defined as a barrier;

^I Total of *employed* mothers (n=18) was the denominator used for this item.

Bi-variate one-way analysis of variance results showing average number of positive responses to oral health behaviors by demographic indicator

Table 5

	N	Mean	SE	F	p-value	η^2
Education						
12th grade or GED (includes vocational/technical certificate)	21	4.05	0.37	4.92	0.03	9&percent;
At least some college	31	5.45	0.46			
Employment Status						
Employed full or part time	21	5.71	0.54	4.03	0.05	8%
Unemployed (includes students, homemaker, disabled)	29	4.41	0.39			
Relationship Status						
Married or living with partner	31	5.42	0.43	3.40	0.07	7%
Divorced, separated, or never married	19	4.21	0.46			
Median Income						
\$20,000	25	4.68	0.35	1.316	0.257	< 3%
> \$20,000	24	4.21	0.46			

Table 6
Analysis of Covariance results showing the relation between educational status, oral health knowledge and beliefs, barriers to oral health care, and positive oral health behaviors

Source	Type III SS	df	Mean Sq	F	p-value	Partial Eta Sq	Observed Power
Corrected Model	61.9	3	20.63	5.02	0	0.25	0.89
Intercept	0.1	1	0.06	0.02	0.9	0	0.05
Oral Health Knowledge and Beliefs	16.4	1	16.42	3.99	0.05	0.08	0.5
Barriers to Oral Health Care	22	1	22	5.35	0.03	0.1	0.62
Education Status	14.7	1	14.58	3.55	0.07	0.07	0.45
	189.1	46		4.11			
Total	151.1	50					