


Knowledge, Attitudes, Behaviors of Women Related to Pregnancy, and Early Childhood Caries Prevention: A Cross-Sectional Pilot Study

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Abstract

Objective: Health education interventions during pregnancy can influence maternal oral health (OH), maternal OH-behaviors and children's OH. Interventions that can be delivered at anytime and anywhere, for example mobile-health (mHealth) provides an opportunity to address challenges of health education and support activation of women in underserved and rural communities to modify their health behavior. This pilot study was undertaken as a part of a mHealth initiative to determine knowledge, attitudes, and behaviors related to pregnancy and ECC prevention among women attending obstetrics/gynecology (OB/GYN) practices at a large rurally-based clinic. **Methods:** A cross-sectional survey study was voluntarily engaged by women (n = 191) aged 18 to 59 years attending OB/GYN visits, over a 3-week period from 12/2019 to 1/2020. Survey results were analyzed applying descriptive statistics, χ^2 and Fisher's Exact tests. The significance level was set at $P < .0001$ for all analyses. **Results:** Approximately half of respondents were between 18 and 29 years (53%), had a college degree (55%), and 100% reported cell phone use. Whereas 53% and 31%, respectively, indicated that they were "somewhat" or "very" sure of how to prevent ECC in their children, only 9% recognized evidence of early decay and 30% did not know the purpose of fluoride. Overall, only 27% of participants correctly answered the knowledge-based questions. Further, only 57% reported their provider explained things in a way that was easy to understand. Only 24% reported seeing a dentist during their current pregnancy. **Conclusions:** Study results suggested potential gaps in knowledge and behaviors related to ECC prevention and provided baseline data to inform future interventions to improve ECC prevention practices. Notably, majority of participants used their cell phones for making medical/dental appointments and reported using their phones to look up health-related information. This demographic represents a potentially receptive target for mHealth approaches to improve understanding of oral health maintenance during pregnancy and ECC prevention.

Keywords

early childhood caries, health promotion, health literacy, primary care, underserved communities, obstetrics

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Introduction

Dental caries or tooth decay is largely preventable with appropriate early intervention.¹ Yet, early childhood caries (ECC) is the most common chronic disease and most unmet health need among young children in the United States. The importance of potential sequelae and systemic impact remains under-recognized.² This form of caries usually begins as white spots (demineralization) along the margin of the gingiva in maxillary anterior tooth surfaces of infants and toddlers.³ The evidence suggests that children who experience ECC are at higher risk for caries in their permanent teeth.⁴ Moreover, ECC increases risk for other

negative impacts on children's quality of life and health.⁴ Further, there are financial consequences⁵ of ECC that include increased cost associated with treatment under

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general anesthesia, emergency department visits, and sustained risk for caries over the course of a child's lifetime.^{5,6}

Oral health literacy (OHL) is defined as "the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions."^{1,7} Our definition of OHL aligns with the definition of American Dental Association (ADA), which includes knowledge and understanding in order to take actions to support one's health.⁷ The high prevalence of untreated dental caries among pregnant women in the US⁸ suggests they have low OHL related to ECC prevention.⁹ Low maternal OHL increases the likelihood of vertical transmission of cariogenic bacteria from mother to child when the mother has untreated dental caries.^{6,10}

Currently, a gap exists between what is known about the pathophysiology and clinical practice related to ECC prevention and associated levels of OHL of both health providers and pregnant women.^{4,11,12} Low OHL among individuals has been associated with lower levels of knowledge and understanding,^{11,13,14} higher rates of dental caries, higher rates of no-shows for dental appointments,⁵ and decreased of quality of life.¹⁵ Pregnant women with low OHL may not understand the importance of maintaining oral health during pregnancy and may be unaware that poor maternal oral health may be associated with negative pregnancy outcomes and can affect the oral and overall health of their child.¹⁵ In addition, parents of young children who have low OHL may not recognize the value or purpose of prophylactic interventions including fluoride exposures and dental sealants in caries prevention for themselves or their children.^{13,14}

The high rates of dental caries in children indicate the need to establish interventions to reduce ECC. Health education interventions during pregnancy can influence maternal oral health, maternal oral health behaviors and children's oral health. Interventions that can be delivered at anytime and anywhere, for example mobile health (mHealth) provides an opportunity to address challenges of health education and support activation of women in underserved and rural communities to modify their health behavior. This pilot study was undertaken as a part of a mHealth initiative and we collected information on cell-phone usage to assess the feasibility of an mHealth approach to increase maternal OHL. This study assessed health literacy, knowledge, experiences, and practices related to dental caries prevention among women attending obstetrics and gynecology (OB/GYN) practices of a large clinic serving a rurally-based community in Wisconsin.

Methods

The survey was conducted at Marshfield Clinic Health System (MCHS), one of the largest multispecialty group

practices in the country with more than 52 medical centers throughout the central, northern and western Wisconsin service area.¹⁶ MCHS features an integrated medical and dental environment with dental care delivered regionally by the Family Health Center of Marshfield, Inc (FHC), a federally qualified health center (FQHC) that also serves low-income, underinsured, and uninsured people.

A cross-sectional study design was used among a convenience sample of patients at the OB/GYN department of MCHS. We developed a paper-based survey instrument written at a 5th grade reading level, in English, consisting of 24 questions. Questions were adapted from previously validated instruments that are widely used.^{17,18} Face validity analyses was conducted by the study team members (NS, AH) and content validity analyses was performed by all the co-authors. The instrument was then pilot tested among 10 patients in the OB/GYN department for readability and time completion. Survey administration was anonymous and voluntary. The survey was distributed to patients by appointment coordinators at time of check-in at the MCHS's OB/GYN department over a 3-week period from December 2019 to January 2020. All patients between 18 and 59 years of age were eligible to participate in the survey. An oral health kit including a toothbrush and toothpaste was offered as an incentive to the participants who completed the survey.

The survey instrument consisted of socio-demographic, knowledge assessment, opinion, and behavioral practice pattern questions. Socio-demographic questions included participant's age, race, ethnicity, level of education, and insurance status. Knowledge-based assessment included 3 questions related to caries prevention, early sign of tooth decay and fluoride use. Opinion-based assessment captured opinions regarding importance of baby teeth, prevention of child caries, tooth-loss at older age, source for oral health information, and how their healthcare provider communicated with them at appointments. Provider communication questions asked if the healthcare provider listened carefully to the patient, showed respect for the patient, spent enough time with the patient and also included questions that assessed health literacy for example: whether provider explained information in a way that was easy to understand and if the patient was comfortable raising oral health concerns with their healthcare provider. We also asked patients about their comfort level with reading printed health materials. Behavioral questions included their selection for main source of drinking water, tooth-brushing regimens, and compliance with recommended dental treatment.

Completed surveys were collected daily at survey distribution sites and survey responses were entered into (Research Electronic Data Capture) REDCap database.¹⁹ We calculated the interrater reliability for 10% of the data entered into the REDCap based on percent agreement. Missing data were excluded from the analyses. Descriptive statistics were used to summarize the data. We used the

scalar-scoring system for analyzing the knowledge-based questions. For every knowledge-based question, there was only 1 correct answer which was given 1 point; an incorrect answer was given 0. Percentage was calculated by dividing the sum of correct answers by the total number of points possible and multiplied by 100. Questions associated with opinions and practice-based questions used a 5-point Likert Scale where 1=Very important/Very Sure/Yes/Always/Extremely sure; 2=Somewhat important/Somewhat sure/Probably-Yes/Often/Quite sure; 3=Not important/Somewhat unsure/No/Occasionally/Somewhat sure; 4=No opinion/Very unsure/Probably No/Sometimes/A little sure; and 5=Don't know/Not sure/ No Opinion/Never/Not sure at all. Three of the questions also use a 4-point Likert scale, where 1=Always, 2=Sometimes, 3=Usually, and 4=Never. For purposes of broadly evaluating the responses to knowledge-based questions, we categorized the responses as correct answer and all incorrect answers as "Other." Chi-square test was used to compare differences in responses based on the participants' age (stratified into: 18-29, 30-59); educational levels (stratified as high school and some college or higher); and dental insurance (yes and no). Fisher's Exact test was performed for comparing the difference in percentage of participants who reported: (a) drinking tap water and knowledge of fluoride; (b) education-all levels versus knowledge of early sign of tooth decay; and (c) use of cell phone versus reading printed health materials. All data analyses were carried out using SAS Version 9.4, English. The level of significance was set at $P < .0001$ for all analysis to indicate the strength of the differences. The study was reviewed and granted exempt status by the Marshfield Clinic Research Institute's Institutional Review Board.

Results

Time for completion of the survey was estimated at 3 to 5 min. Inter-rater reliability for entering data into REDCap was 99%.

Participant Demographics

A total of 193 patients returned the survey. Two incomplete surveys were not included in the analyses. Fifty-three percent (93/176) of women were 18 to 29 years and 47% (83/176) were between 30 and 59 years of age, respectively. The majority (87% [167/180]) of participants indicated that they were Caucasian and non-Hispanic/Latin, and approximately 45% (79/177) reported their level of education as less than high school to some college. Ninety percent (160/177) of participants reported that their insurance included dental benefits. The percentage of individuals reporting use of cell phone was 100%. Participants reported use of their cell phone for the following purposes: send/receive text messages (164); Make medical and dental

Table 1. Participant Responses to the Question "What is the Best Way to Prevent Tooth Decay?"

a. Brushing teeth	125 (65.45%)
b. Brushing teeth with fluoride toothpaste	43 (22.51%)
c. Going to a dentist	31 (16.23%)
d. Limiting sweets/diet	25 (13.09%)
e. Flossing teeth	20 (10.47%)
f. Cleaning infant's gums	12 (6.28%)
g. Using fluoridated water	4 (2.09%)
h. Using fluorides (fluoride varnish/supplements)	3 (1.57%)
i. Other	3 (1.57%)
j. Pit and fissure sealants	1 (0.52%)
k. Don't know	1 (0.52%)

appointments (117); Look up health information (112); Access patient portal (71); access after visit summary (52) and 14 were missing. Approximately 72% (131/182) of participants reported drinking tap water. The 28% who reported not drinking tap water indicated the following reasons: "tastes terrible" (14%), "my family drinks bottled water" (9%), "unsafe" (5%), and "other" (9%) that included drinking filtered tap water and well water.

Oral health knowledge. We asked participants about the best way to prevent tooth decay. Based on the scoring system, only (194/722 points) 27% was answered correctly. The most frequently selected response was "brushing teeth" (65%) while only 22.5% indicated the correct response as "Brushing teeth with fluoride toothpaste" (Table 1). When asked "what do you think fluoride is used for," 70% indicated "used to prevent tooth decay." The other most frequently selected responses were "used to prevent plaque" (14%), "used to clean teeth" (7%), "used to purify water" (5%), "used to whiten teeth" (3%), and "other/don't know/not sure" (9%). Only 9% correctly recognized "white spots on a child's front teeth" as an early sign of tooth decay. Table 2 shows the distribution of self-reported information related to drinking tap water and knowledge related to role or use of fluoride in preventing tooth decay and educational levels and knowledge of early signs of tooth decay.

Oral/health behaviors. The majority of participants (85%) reported most recent tooth-brushing on the morning of their appointment. Use of toothpaste, baking soda, or coconut oil and hydrogen peroxide was reported by 97%, 3%, and 1%, respectively. A visit to their dentist during their current pregnancy was reported by 24%, while 37% indicated no visit, 34% declined to answer, and 5% could not recall.

Opinions related to oral health. Approximately 69% of participants indicated that baby teeth were "very important." Notably 53% and 31% of the participants respectively, indicated they were "somewhat sure" or "very sure" of how to

Table 2. Distribution of Self-reported Information Related to: (1) Drinking Tap Water and Knowledge Related to Use of Fluoride, and (2) Educational Levels and Knowledge of Early Signs of Tooth Decay.

1. Do you drink tap water?	What do you think Fluoride is used for?			P-value
	Prevent tooth decay	All other responses	Total	
No	37 (27.61%)	15 (39.47%)	52	.0589
Yes	97 (72.39%)	23 (60.53%)	120	
Total	134	38	172	

2. Educational levels	Early sign of tooth decay			P-value
	White spot on child's front teeth	All other responses	Total	
Less than high school	5 (33.33 %)	50 (34.72%)	55	.2263
Some college degree or higher	10 (66.67%)	94 (65.28%)	104	
Total	15	144	159	

prevent dental caries in their children. The majority (94%) reported their dentist as the most important source for oral health information. Table 3 summarizes the self-reported opinions of participants regarding health related education and care providers communication. A significant difference ($P < .0001$) between having dental insurance and not having dental insurance was seen when they were asked if providers explained things in a way that was easy to understand and if provider spent enough time with the participants during their visits, with higher frequency reported by those who had dental insurance, respectively. Approximately, 66% of participants who had some college or higher indicated that they could follow the written instructions on a bottle of Tylenol or Aspirin compared with participants who had high school education or less ($P < .0001$). Similarly, participants with some college or higher were more comfortable asking their medical provider about their teeth or gum concerns ($P < .0001$).

Discussion

Evidence-based research indicates that health education during pregnancy can have a profound influence on maternal oral health, maternal oral health behaviors and on children's oral health.⁹ Overall, this study found that more than half of respondents reported they were generally aware of ways to prevent tooth decay. Importantly, 57% of the participants reported their provider explained things in a way that was easy to understand; while 74% reported confidence in their capacity to read and understand printed healthcare associated material without assistance.

A 2009 study by Lucey,²⁰ found that children of pregnant women who had received printed information emphasizing the importance of achieving and maintaining good oral health and proper nutritional intake during pregnancy, had a lower rate of incident ECC (1.7%) compared to the incident ECC rate (9.7%) observed among children of women in the

Table 3. Summarizes opinions of participants regarding health-related education and care providers communication.

1. Your provider explained things in a way that was easy to understand	
a. Always	62.2% (109/175)
b. Usually	36.6% (64/175)
c. Sometimes	0.6% (1/175)
d. Never	0.6% (1/175)
2. Your provider spent enough time with you	
a. Always	65.3% (115/176)
b. Usually	29.5% (52/176)
c. Sometimes	4.5% (8/176)
d. Never	0.6% (1/176)
3. I am comfortable asking my provider about concerns with my teeth/gums	
a. Always	71.5% (128/179)
b. Usually	22.9% (41/179)
c. Sometimes	5.0% (9/179)
d. Never	0.6% (1/179)
4. How often do you have someone help you read printed materials that your health care provider gave you?	
a. Always	7.3% (13/177)
b. Usually	0.6% (10/177)
c. Sometimes	14.1% (25/177)
d. Never	72.9% (129/177)

control group who had received no education. Taken together, these data suggest that increasing OHL in pregnant women by providing educational materials related to the importance of achieving and maintaining good oral health during pregnancy, could increase patient understanding, and patient activation.

Patients' health decisions are influenced by their health providers' knowledge, guidance, and communication practices. Notably, OHL levels among medical providers related to dental caries prevention in young children is either lacking or they are not communicating their knowledge

effectively to patients.^{11,21} These data further support the need for integration of more training and expansion of the curriculum related to oral and systemic health education for medical professionals.^{21,22}

A 2017 review by Finlayson et al²³ found that clinical and educational interventions during pregnancy are effective in reducing mother-child transmission of bacteria and ECC. The American College of Obstetricians and Gynecologists (ACOG) provide guidance on oral health counseling to pregnant patients. For pregnant women and new mothers, ACOG recommends obstetricians provide patient education related to oral health and pregnancy to all pregnant women and new mothers. In the current study, a majority (94%) of participants reported that dentists were the most important source for oral health information. This suggests that an alternative model of care promoting oral health in both medical and dental settings may more effectively increase OHL among patients visiting the OB/GYN departments.

In the current study, only 24% of the participants indicated they visited the dentist during their pregnancy. These rates are lower than those reported by a 2014 NHANES report, where 62% reported a dental visit during pregnancy.²⁴ In the current study, 37% of the women indicated they had not had a dental visit at the time of survey participation and an additional 33% elected not to answer this question. However, due to the cross-sectional design of this study, we project that the actual rate of attendance among this sample of pregnant women may have been higher since, some participants may not have had a dental appointment during their pregnancy at the time they completed the survey and may have had a dental visit later in their pregnancy post survey participation. Because the women were only surveyed once, the true rate of dental visits among our study cohort is not known and represents a study limitation.

Interestingly, all participants reported using a cell phone. Notably, >60% of participants used their cell phones for making medical and dental appointments and nearly 70% reported using their phones to look up health-related information. Various initiatives have been employed nation-wide where cell phones have been used as a venue to help address challenges of health literacy and support activation of women in underserved and rural communities to modify their health behaviors.²⁵⁻²⁷ Text messaging for oral health behavior interventions could be encompassed as part of the broader strategy of mHealth.

This study has some limitations. Since survey context represents self-reported data, our ability to validate findings are limited. Being a pilot effort, the survey tool validation was limited to face and content validity. Number of patients who declined the survey was not tracked, thus the survey response rate is unknown. Moreover, respondents may have had more interest in oral health and awareness of its importance, so there is a potential risk of bias if women lacking such interest declined participation. Data

were collected at a single healthcare system and may not be generalizable to other healthcare settings. Studies in other populations are needed to confirm validity of findings in our population.

Conclusions

Our data provides a baseline for OHL related to dental caries prevention in gravid women and women with young children across the largely rural population where the survey was conducted. The results of the study are helpful to understand patient receptivity to integrated care delivery practices and help in advancing opportunities for development of educational tools to increase patient and provider literacy. Findings from the present study support educational initiatives leveraging targeted distribution approaches, such as use of text messaging for transfer of health-related communications or inclusion of health-related messages in after visit summaries.²⁸ Such interventions may be warranted to improve OHL related to the importance of oral health maintenance during pregnancy among both physicians and patients. Further, this exploratory study may serve as a model to inform development of m-Health interventional study using cell phones within the integrated environment available in this setting. Studies in other populations are needed to confirm validity of findings in our population. Initiatives involving behavioral interventions utilizing novel educational approaches to increase provider and patient OHL will inform development of an alternative integrated care delivery model.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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