The Association Between Socio-demographic Factors, Dental Problems, and Preterm Labor for Pregnant Women Residing in Hawai'i

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Abstract

Periodontal disease during pregnancy has the potential to increase the risk of adverse perinatal outcomes including preterm labor (PTL), prematurity, and low birth weight (LBW). Despite professional recommendations on the importance and safety of dental assessments and treatments, the rate of dental care utilization during pregnancy remains low. The purpose of this study was to document the utilization of dental services and explore the relationships among socio-demographic factors, dental problems, and PTL in pregnant women residing in Hawai'i. Hawai'i Pregnancy Risk Assessment Monitoring System (PRAMS) survey results were analyzed from 4,309 women who experienced live births between the years 2009-2011. Results revealed that 2 in 5 women in Hawai'i had their teeth cleaned during pregnancy, while 1 in 5 reported seeing a dentist for a dental problem. Women who reported having a dental problem during pregnancy were more likely to experience PTL (OR=1.46, 95% CI=1.10-1.94, P=.008) compared to women without a dental problem. In addition, Native Hawaiian and Part-Hawaiian women were more likely to experience PTL (OR=1.73, 95% CI=1.22-2.46, P=.002) compared to Caucasian women. These findings document the underutilization of dental services in pregnant women in Hawai'i and reveal an association between poor dental care and PTL. Identification of groups at risk for maternal complications may assist in the development of programs that are sensitive to the diverse cultures and variability of community resources that exist throughout Hawai'i.

Keywords

pregnancy, preterm labor, dental, Hawai'i, PRAMS

Introduction

Preterm labor (PTL) is a leading cause of neonatal morbidity and mortality. In the United States, nearly 500,000 infants annually (11.4% of births) are born prematurely.[1] There are several known risk factors including low socioeconomic level; maternal use of tobacco, alcohol, and drugs; and pre-existing medical conditions such as asthma, diabetes, hypertension, and kidney infections.[1-3] However, in approximately 50% of women experiencing PTL, risk factors are not identified resulting in a lack of timely initiation of interventions that could reduce or prevent premature births.[3,4] There has been recent interest in whether poor maternal oral health prior to and during pregnancy, which is often overlooked, may be a critical risk factor for PTL. It is believed that existing oral health problems before and during pregnancy may facilitate the development of other infections as well as initiate an inflammatory cascade that can result in PTL.[5-7]

Physiological changes of pregnancy, primarily due to hormonal, anatomic, and biochemical alterations associated with gestation, can induce several oral conditions. These conditions include pregnancy-associated gingivitis, benign oral gingival tumors (ie, epulis of pregnancy), and loose teeth. Approximately 40% of pregnant women experience some type of periodontal disease.[8-10] Therefore, it appears that the pregnant state can contribute to the development or acceleration of oral tissue inflammation and enamel degradation resulting in periodontal disease.

Peridontal disease during pregnancy is associated with increased rates of pre-eclampsia, PTL, preterm birth (PTB), and low birth weight (LBW) infants.[6,11-13] The exact mechanisms by which these complications occur are not clearly delineated. Proper maternal dental care and regular dental visits have been documented to decrease the risk of perinatal complications, decrease the transmission of oral cariogenic bacteria from mothers to their infants, and reduce the development of early childhood caries.[14,15]

Disparities in both oral health services and oral health outcomes have been documented, with dental disease disproportionately impacting racial and ethnic minorities, persons living below the federal poverty level, persons with less than a college education, and those engaging in behaviors that contribute to overall poor health outcomes.[16-18] Pregnant women are among vulnerable populations that are at high risk for developing significant dental disease.[16,17] In addition to limited access to dental care for pregnant women, the lack of women's knowledge about the importance of dental care contributing to healthy pregnancy outcomes[19,20] and health professionals misperceptions about the safety of dental care during pregnancy are additional barriers that increase rates of dental disease and associated perinatal complications.[21,22]

Several studies have documented disparities in dental health service utilization leading to maternal dental disease and adverse perinatal health outcomes.[16-20] However, the majority of these studies combine most of Hawai'i's racial groups, making comparisons between these groups unavailable. In addition, Hawai'i faces unique challenges to improving oral health for its residents. Existing challenges for the State of Hawai'i include its geography, lack of water fluoridation, cultural diversity, the lack of a dental school in the State, and the lack of dental coverage for individuals with Quest (Medicaid) insurance. Currently in the State of Hawai'i, adults 21 years of age and older who have Quest coverage have limited dental benefits which consist of emergency care only. The purpose of this study was to report the utilization of dental health services, and to explore the relationships among socio-demographic factors, dental problems and PTL for pregnant women residing in Hawai'i.

Methods

Data Source

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a partnership project developed and managed by the Centers for Disease Control and Prevention (CDC). Grant funds that are available through the CDC allow for state collaborations and data analysis. The PRAMS questionnaire collects population-based data on demographics, maternal attitudes, and experiences before, during, and after pregnancy.

The PRAMS questionnaire has two parts: (1) core questions asked by all states; and (2) additional questions chosen by each state from questions developed by the CDC or by the individual states based on their need. For Hawai'i, approximately 200 new mothers each month are randomly selected from available birth certificate data to receive a PRAMS survey (available at: http://health.hawaii.gov/mchb/files/2013/05/PRAMS3.pdf). A total of two additional surveys are mailed to women not responding, followed by a telephone survey for non-responders.

The study was approved by the Department of Health (DOH), Hawai'i PRAMS Program. During 2009-2011, 6,641 PRAMS surveys were sent to women in Hawai'i with 4,735 women responding, a response rate of 71%. The analysis for this study included 4,309 women with Quest (n=1,717) or private insurance (n=2,430) during pregnancy. Women with military (Tri-care) insurance were excluded due to coverage variability based on active duty versus reserve duty status (n=426).

Study Variables

Table 1 represents the PRAMS survey questions related to Health included in the study. Oral health variables included: teeth cleaning before, during, and after pregnancy, experiencing a dental problem during pregnancy, visit to a dentist or dental clinic during pregnancy for care, and oral hygiene counseling (ie, talked to dental or health care worker about how to care for teeth and gums) during their most recent pregnancy.

Maternal characteristics/predictors included: oral health variables, insurance coverage during pregnancy, income, mother's education, age, race, marital status, county of residence in Hawai'i, maternal behaviors (smoking, alcohol use, substance use [marijuana, amphetamines, cocaine/heroin, tranquilizers/hallucinogens or sniffing]), prescription drug use, pre-existing medical conditions (asthma, diabetes, and hypertension), and previous pregnancy outcomes (previous premature birth and previous normal weight infant) based on PRAMS survey question data. The perinatal outcome of our interest was PTL identified by maternal responses to PRAMS survey questions.

Table 1. PRAMS Survey Questions Related to Health Included in the Study	
PRAMS Question	**Variable**
Oral Health:	
• At any time during the 12 months before you got pregnant with your new baby, did you have your teeth cleaned by a dentist or a dental hygienist? (Yes/No)	Dental cleaning before pregnancy
• I needed to see a dentist for a problem during my most recent pregnancy. (Yes/No)	Dental problem during pregnancy
• I went to a dentist or a dental clinic during my most recent pregnancy. (Yes/No)	Sought dental care during pregnancy
• Dental or other health care worker talked with me about how to care for my teeth and gums during my most recent pregnancy. (Yes/No)	Oral hygiene counseling during pregnancy
• Did you have your teeth cleaned by a dentist or dental hygienist during my most recent pregnancy? (Yes/No)	Dental cleaning during pregnancy
• Did you have your teeth cleaned by a dentist or dental hygienist after my most recent pregnancy? (Yes/No)	Dental cleaning after pregnancy
Maternal Behavior:	
• Have you smoked any cigarettes in the past 2 years? (Yes/No)	Smoked in past 2 years
• Have you had any alcoholic drinks in the past 2 years? (Yes/No)	Alcohol drinking in past 2 years
Medications:	
• Did you use prescription drugs in the month before you got pregnant? (Yes/No) If yes, what kinds?	Use of prescription drugs before pregnancy
• Did you use any of these drugs when you were pregnant? For each item, circle Y (Yes) if you used it or circle N (No) if you did not. (Same as above)	Use of prescription drugs during pregnancy
• Did you use any of these drugs in the month before you got pregnant? b=Marijuana (pot, bud) or hashish (hash); c=Amphetamines (uppers, ice, speed, crystal meth, crank); d=Cocaine (rock, coke, crack) or heroin (smack, horse); e=Tranquilizers (downers, ludes) or hallucinogens (LSD/acid, PCP/angel dust, ecstasy); f=Sniffing gasoline, glue, hairspray, or other aerosols)	Substance use before pregnancy
• Did you use any of these drugs in the month when you were pregnant? b=Marijuana (pot, bud) or hashish (hash); c=Amphetamines (uppers, ice, speed, crystal meth, crank); d=Cocaine (rock, coke, crack) or heroin (smack, horse); e=Tranquilizers (downers, ludes) or hallucinogens (LSD/acid, PCP/angel dust, ecstasy); f=Sniffing gasoline, glue, hairspray, or other aerosols)	Substance use during pregnancy
Medical Conditions:	
• Before you got pregnant with your new baby, were you ever told by a doctor, nurse, or other health care worker that you had Type 1 or Type 2 diabetes? This is not the same as gestational diabetes or diabetes that starts during pregnancy. (Yes/No)	Diabetes before pregnancy
• During the 3 months before you got pregnant with your new baby, did you have asthma? (Yes/No)	Asthma before pregnancy
• During the 3 months before you got pregnant with your new baby, did you have hypertension? (Yes/No)	Hypertension before pregnancy
Previous Pregnancy Outcomes:	
• Did the baby born just before your new one weigh more than 5 pounds, 8 ounces (2.5 kilos) at birth? (Yes/No)	Previous normal weight birth
• Was the baby just before your new one born more than 3 weeks before his or her due date? (Yes/No)	Previous premature birth
Preterm Labor Outcome:	
• Did you have the signs and symptoms of preterm labor (labor more than 3 weeks before the baby is due) during your most recent pregnancy? (Yes/No)	Preterm labor

Analyses

Statistical analysis was conducted using SAS software, version 9.4 (SAS Institute Inc., Cary, NC). Initial data analysis generated descriptive statistics (Table 2) followed by bivariate analyses using chi-square tests (Table 3) to examine the association between maternal dental problems and PTL including potential confounders (eg, demographics, maternal behaviors, pre-existing medical conditions, prescription medications, and previous pregnancy outcomes). Bivariate analyses in Table 3 revealed an association of $P < .1$ between PTL and the following variables: age, race, education, marital status, insurance, county, dental problems during pregnancy, oral hygiene counseling during pregnancy, smoked in the past 2 years, alcohol drinking in the past 2 years, use of prescription drugs before and during pregnancy, asthma before pregnancy, previous premature birth, and previous birth with normal weight. These variables were included in the multivariable logistic regression. Using backward selection method, the final significant variables associated with PTL in the multivariable logistic regression model were race, age, dental problem during pregnancy, oral hygiene counseling during pregnancy, use of prescription drugs before pregnancy, asthma before pregnancy, and previous premature birth (Table 4). For all the analyses, the PRAMS' complex sampling design was taken into account using appropriate analytic modules (eg, PROC SURVEYFREQ, SURVEYMEANS and SURVEYLOGISTIC).

Protection of Human Subjects

The study was considered to be in the exempt category based on the current federal institutional review board regulations. All researchers agreed to the terms of the Hawai'i PRAMS data sharing agreement.

Results

A total of 4,309 women who experienced live births between the years 2009-2011 were included in the study. Table 2 provides the demographic characteristics of the study population. The largest represented group was Native Hawaiian/Part-Hawaiian women (34.4%). Over half (53.5%) of the women responding reported incomes of <$35,000, and 48% of women had a high school education or lower.

Maternal experiences with oral health services are also provided in Table 2. During pregnancy, almost 20% of women reported seeing a dentist for a dental problem. There is a stepwise decline in dental cleaning from before pregnancy (49.5%) of women, to during pregnancy (39.5%), and a further decline during the year after birth (25.9%). Before and during pregnancy, 7.1% and 3.4% of women reported substance use (eg, marijuana, cocaine, tranquilizer, sniffing, etc.), respectively. However, very few women reported using non-marijuana illicit drugs before and during pregnancy (<1% for each illicit drug).

Bivariate associations between PTL and the following variables were significant: age ($P < .001$), race ($P < .001$), education ($P = .0013$), insurance ($P < .001$), county ($P < .001$), dental problems during pregnancy ($P < .001$), oral hygiene counseling during pregnancy ($P = .016$), smoked in the past 2 years ($P < .001$), alcohol drinking in the past 2 years ($P = .039$), use of prescription drugs before ($P < .001$) and during pregnancy ($P < .001$), asthma before pregnancy ($P < .001$), previous premature birth ($P < .001$), and previous birth ($P = .006$) with normal weight.

Results of the multivariable logistic regression for PTL are displayed in Table 4. Native Hawaiian/Part-Hawaiian women were more likely to experience PTL (OR=1.73, 95% CI=1.22-2.46, P=.002) than Caucasian women. Women who reported having dental problems during pregnancy were more likely to have PTL (OR=1.46, 95% CI=1.10-1.94, P=.008). Conversely, women who received oral hygiene counseling during pregnancy were less likely to experience PTL (OR=0.72, 95% CI=0.57-0.92, P=.008). Predictably, women who had a previous premature birth were more likely to have PTL (OR=2.89, 95% CI=2.00-4.20, P<.001). The analysis also found that women who reported the use of prescription drugs prior to pregnancy were also more likely to have PTL (OR=2.13, 95% CI=1.58-2.87, P<.001), as were women who reported having asthma before pregnancy (OR=1.70, 95% CI=1.20-2.39, P=.003).

Table 2. Demographics, Clinical Features, and Oral Health Characteristics of Study Population			
Variable	N (Total=4,309)	Weighted %	Standard Error
Demographics			
Age (years)			
<20	356	7.9	0.5
20-24	953	22.9	0.9
25-29	1,141	25.7	0.9
30-34	1,042	24.6	0.9
≥35	817	18.9	0.8
Race			
Caucasian	811	15.5	0.7
Native Hawaiian /Part-Hawaiian	1,493	34.4	1.0
Filipino	856	19.6	0.8

Table 2 continues on the next page

Table 2. Demographics, Clinical Features, and Oral Health Characteristics of Study Population (Con't)

Variable	N (Total=4,309)	Weighted %	Standard Error
Other Pacific Islander	277	8.2	0.6
Other Asian	656	17.9	0.8
All Others	216	4.3	0.4
Education			
Less than high school	364	8.5	0.6
Completed high school and/or graduated	1,711	39.5	1.0
Some college	993	22.3	0.8
Completed college/higher degree	1,184	29.7	0.9
Income			
<$10,000	870	21.9	0.9
$10,000-$24,999	905	21.2	0.9
$25,000-$34,999	414	10.4	0.7
$35,000-$64,999	923	22.4	0.9
≥$65,000	924	24.1	0.9
Marital Status			
Married	2,349	55.6	0.1
Other	1,960	44.8	0.1
Insurance			
Quest (Medicaid)	1,717	40.6	1.0
Private	2,430	59.4	1.0
County			
Hawai'i	981	15.0	0.1
Honolulu	1,628	66.9	0.1
Kaua'i	610	5.3	0.0
Maui	1,090	12.8	0.1
Maternal Oral Health Characteristics			
Dental cleaning before pregnancy	2,121	49.5	1.0
Dental problem during pregnancy	837	19.4	0.8
Sought dental care during pregnancy	1,070	39.5	1.0
Oral hygiene counseling during pregnancy	2,114	50.3	1.0
Dental cleaning during pregnancy	1,430	33.4	1.0
Dental cleaning after pregnancy	1,063	25.9	0.9
Maternal Behaviors			
Smoked in past 2 years	1,072	24.2	0.9
Alcohol drinking in past 2 years	2,680	60.6	1.0
Medications			
Use of prescription drugs before pregnancy	667	14.4	0.7
Use of prescription drugs during pregnancy	896	20.5	0.8
Substance use before pregnancy	350	7.1	0.5
Substance use during pregnancy	179	3.4	0.3
Medical Conditions			
Diabetes before pregnancy	114	2.6	0.3
Asthma before pregnancy	380	7.9	0.5
Hypertension before pregnancy	139	3.2	0.4
Previous Pregnancy Outcomes			
Previous premature birth	300	7.5	0.6
Previous normal weight birth	1,967	49.9	1.0

Notes: The weighted sample size was 47,402. Women with Tri-care insurance were excluded.

Table 3. Bivariate Analysis between Maternal Demographics, Clinical Features, and Oral Health Characteristics with Preterm Labor			
Variable	**Preterm Labor**		
	No (Weighted %)	**Yes (Weighted %)**	**Weighted *P*-value***
Age (years)			
<20	8.1	6.4	<.001
20-24	21.4	31.3	
25-29	25.9	24.1	
30-34	25.2	22.1	
≥35	19.4	16.1	
Race			
Caucasian	15.9	12.8	<.001
Native Hawaiian /Part-Hawaiian	31.7	51.6	
Filipino	20.7	13.4	
Other Pacific Islander	8.9	3.9	
Other Asian	18.8	11.7	
All Others	3.9	6.5	
Education			
Less than High School	8.5	8.5	.003
Completed high school and/or graduated	38.3	45.3	
Completed high school and/or Some college	22.1	24.4	
Completed college/higher (degree)	31.0	21.8	
Income			
<$10,000	21.6	23.8	.530
$10,000-24,999	20.8	23.5	
$25,000-34,999	10.5	10.3	
$35,000-64,999	22.6	21.3	
>$65,000	24.6	21.3	
Marital Status			
Married	48.5	6.6	.060
Other	38.4	6.5	
Insurance			
Quest	39.3	49.3	<.001
Private	60.7	50.7	
County			
Hawai'i	14.3	20.6	<.001
Honolulu	67.6	60.7	
Kaua'i	5.3	5.9	
Maui	12.8	12.7	

Table 3 continues on the next page

Table 3. Bivariate Analysis between Maternal Demographics, Clinical Features, and Oral Health Characteristics with Preterm Labor (Con't)			
Variable	**Preterm Labor**		
	No (Weighted %)	**Yes (Weighted %)**	**Weighted *P*-value***
Dental cleaning before pregnancy	49.4	49.7	.910
Dental problem during pregnancy	18.0	27.5	<.001
Sought dental care during pregnancy	38.9	41.9	.300
Oral hygiene counseling during pregnancy	51.2	44.3	.016
Dental cleaning during pregnancy	33.3	33.3	.990
Smoked in past 2 years	22.8	32.3	<.001
Alcohol drinking in past 2 years	59.9	65.8	.039
Use of prescription drugs before pregnancy	12.6	25.7	<.001
Use of prescription drugs during pregnancy	18.9	30.4	<.001
Substance use before pregnancy	6.0	0.9	.890
Substance use during pregnancy	2.9	0.4	.490
Diabetes before pregnancy	2.6	3.0	.600
Asthma before pregnancy	6.8	14.8	<.001
Hypertension before pregnancy	3.1	3.8	.450
Previous premature birth	6.1	15.8	<.001
Previous normal weight birth	48.9	56.8	.006

*Rao-Scott chi-square tests were used to account for complex sampling design.

Table 4. Adjusted Odds Ratio and 95% Confidence Interval for Preterm Labor			
Variable	**OR**	**95% CI**	**Weighted *P*-value**
Race:			
Native Hawaiian/Part-Hawaiian vs Caucasian	1.73	1.22-2.46	.002
Filipino vs Caucasian	0.69	0.45-1.05	.086
Other Pacific Islander vs Caucasian	0.52	0.26-1.04	.065
Other Asian vs Caucasian	0.79	0.50-1.24	.310
All Others vs Caucasian	1.75	0.96-3.19	.068
Age (years):			
<20 vs ≥ 35	0.93	0.55-1.59	.810
20-24 vs ≥ 35	1.77	1.20-2.60	.004
25-29 vs ≥ 35	1.23	0.84-1.78	.280
30-34 vs ≥ 35	1.21	0.82-1.78	.350
Dental problem during pregnancy: Yes vs No	1.46	1.10-1.94	.008
Oral hygiene counseling during pregnancy: Yes vs No	0.72	0.57-0.92	.008
Use of prescription drugs before pregnancy: Yes vs No	2.13	1.58-2.87	<.001
Asthma before pregnancy: Yes vs No	1.70	1.20-2.39	.003
Previous premature birth: Yes vs No	2.89	2.00-4.20	<.001

OR = Odds Ratio; CI = Confidence Interval.
Note: The multivariable logistic regression includes variables that generated a *P*-value <.10 in bivariate analyses in Table 3, accounting for PRAMS' complex sampling design. Backward selection method was to determine the final model.

Discussion

This study illustrates how the utilization of dental services for women in Hawai'i impacts PTL. We observed an association between poor dental care and PTL in Hawai'i. Our reported decline in preventative dental services (eg, dental cleaning) during pregnancy and the post partum periods is consistent with cohort studies of pregnant women residing in other states in terms of their oral health.[23]

Oral health is a predictor of individual wellbeing throughout life.[16,17] Dental disease is associated with increased rates of chronic conditions including cardiovascular, metabolic, and respiratory diseases.[24,25] It can also lead to inadequate caloric intake, decreased quality of life, decreased work productivity, and increased health care costs.[16,17] The risks associated with poor oral health for pregnant women in Hawai'i adds to our understanding of the negative consequences of having oral health problems before and during pregnancy and the importance of having access to regular dental care.

Access to dental services in Hawai'i can be challenging, especially for those living in rural areas.[8] However, for pregnant women this can be compounded by their need for regular and frequent (ie, at least once/month) prenatal visits. It is likely that prenatal health care is prioritized due to a strong desire to have a healthy infant, whereas dental care, which is not seen as being related to prenatal health, only becomes important when a problem occurs.[8,20] In addition, dental coverage is currently unavailable for pregnant women relying on Quest health insurance, creating an additional barrier for low-income women in need of dental services.

Dental Care for Pregnant Women Residing in Hawai'i

Professional organizations including the American College of Obstetrics and Gynecology (ACOG) and American Dental Association (ADA) currently recommend that pregnant women have a dental assessment every six months and, when indicated, preventive and restorative treatments. The support for these standards of practice are based on the literature documenting the importance of routine dental visits before and during pregnancy, as well as the safety of dental care during all stages of pregnancy.[7,8] However, during 2009-2011, PRAMS survey responses indicated that only 39% of pregnant women in Hawai'i reported having had their teeth cleaned during pregnancy. An equally concerning result from the analysis is the rate of pregnant women seeking dental care for a problem during pregnancy, noted to be one in every five women.

The results of this study are particularly concerning for pregnant women in Hawai'i based on existing evidence and our additional analyses documenting associations between dental problems and PTL. In this cohort, there were higher reported rates of PTL in women who reported a dental problem during pregnancy. Especially noteworthy is the significantly higher rate of PTL in Native Hawaiian women after adjusting for all other variables. This suggests a need for further studies to determine contributing factors that result in higher rates of PTL in Native Hawaiian women.

The use of prescription drugs prior to pregnancy was also found to be associated with an increased risk of PTL. Although the relationship between pre-pregnancy prescription drug use and an increased risk of PTL is unknown, it is possible that the women reporting this were taking medications to treat pre-existing chronic conditions (eg, asthma, etc) that could result in their being at higher risk for PTL.

Finally, the relationship between pre-pregnancy asthma and increased PTL is unclear. However, this may be indicative of a group of women who prior to pregnancy have a tendency for hyperactivity of bronchial and myometrial smooth muscle resulting in an increased risk for developing PTL during pregnancy.[27] In addition, the severity of asthma prior to pregnancy was not reported; however, moderate to severe asthma has been associated with PTL. [27-29]

Strengths And Limitations

This study explored some important gaps in the current literature about disparities in PTL associated with dental problems reported by pregnant women, specifically in the State of Hawai'i. Gaining more knowledge about these associations provides an opportunity to begin to develop and implement strategies that can improve outcomes for women and their infants in identified vulnerable populations. These strategies include educating women and health care providers, including dentists and dental hygienists, about the importance of maintaining/improving maternal oral health prior to and during pregnancy; and improving access to preventative and restorative dental services for pregnant women. Informing policy makers and legislators about the importance of including dental coverage in health insurance plans (both Quest and private) is an important and necessary step to preventing adverse perinatal outcomes associated with maternal dental disease.

This study has several limitations. The study relied on self-reported data. Women were asked to report on behaviors and events that occurred before, during, and after their pregnancy, which may increase recall bias. Additionally, self-reports may not reflect actual behaviors, particularly if questioning socially undesirable behaviors such as alcohol use, smoking, or other substance use/abuse during pregnancy. Also, varying interpretations of survey questions may be based on respondents' levels of education, native language, reading comprehension, and/or the use of an interpreter to assist in completing the survey.

Specific details regarding the use of prescription medications during pregnancy (medication dosage, frequency of administration, medical indications, and time frame during pregnancy [trimesters] when medications were being taken) could not be determined. This information may help clarify the severity of a medical condition and its possible effects on the outcome of the pregnancy. The survey question pertaining to having a dental problem during pregnancy that required a dental visit also did not allow for further elaboration about the onset or the severity of the dental problem (eg, gingival swelling, a dental abscess or pain due to caries formation, or a benign epulis formation). These details can help to more accurately determine possible

causes for PTL. It is also unknown when the dental problem occurred during the pregnancy or whether the problem existed prior to but progressed during pregnancy, requiring emergent care. Adults lacking dental coverage may not feel that preventive dental services are required and, therefore, may only seek care when a problem exists.

Since PRAMS does not collect data on dental insurance status it was difficult to determine if women covered by private medical insurance had dental coverage. However, for those women on Quest, only emergency dental services are included in their coverage. Since respondents with non-Quest medical insurance may or may not have dental coverage as part of the plan, it is probable that our analysis of the relationship between insurance and accessing dental care is under-estimated. There was a need to combine ethnic groups including Japanese, Chinese, Korean, Vietnamese and Other Asians based on Hawaiʻi PRAMS guidelines stating that estimates based on un-weighted cell sizes of less than 10 or un-weighted marginal values of less than 30 cannot be published. Combining these ethnic groups limited our ability to determine the extent that ethnicity contributed to pregnancy outcomes for these five distinct ethnic groups.

Results from portions of the current analyses focusing on rural areas (eg, Hawaiʻi County) may have significance for rural regions of the US with similar demographic challenges. However, these results will need validation through future studies comparing the findings from the current study with other states participating in PRAMS with similar geographical challenges.

Conclusions And Implications

Pregnancy is a unique opportunity for health promotion and disease prevention that impacts the health of a woman, her fetus, and her infant. This study provides a basis for increased efforts to improve the oral health of childbearing age women in Hawaiʻi by educating primary care providers about the importance of oral health assessment, patient education, and patient referrals for preventive and restorative dental care; and by advocating for the expansion of health care benefits for pregnant women to include dental coverage.

Community oral health initiatives focused on identifying high risk groups in Hawaiʻi, as well as encouraging interdisciplinary collaborations, are essential components to improving oral health services and outcomes for families in Hawaiʻi. Changing oral health beliefs and behaviors of mothers in Hawaiʻi could also help to create positive behaviors in their children, potentially reducing the rate of early childhood caries. There are important clinical and policy implications that may be gleaned from these findings. For example, promoting legislation to include dental coverage for pregnant women regardless of their current medical insurance has the potential to increase the utilization of dental services by the women for both preventive and restorative care. Education of primary health care providers about the importance of regular dental assessments and treatments in pregnant women is needed. Finally more research is needed in this area to understand the relationships between dental problems and perinatal complications, especially in Native Hawaiian and Other Pacific Islander women.

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References
1. Preterm birth. Center for Disease Control and Prevention Web Site. http://www.cdc.gov/reproductivehealth/MaternalInfantHealth/PretermBirth.htm. Published December 23, 2014. Accessed July 1, 2015.
2. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. *Lancet.* 2008;371(9606):75-84.
3. Romero R, Dey SK, Fisher SJ. Preterm labor: one syndrome, many causes. *Science.* 2014;345(6198):760-765.
4. Kilpatrick SJ. Prediction and prevention of preterm birth: What have we learned since 2001? *Contemporary OB/GYN.* 2013. Retrieved from http://contemporaryobgyn.modernmedicine.com/contemporary-obgyn/news/modernmedicine/modern-medicine-feature-articles/prediction-and-prevention.
5. Mesa F, Pozo E, Blanc V, Puertas A, Bravo M, O'Valle. Are periodontal bacterial profiles and placental inflammatory infiltrates in pregnancy related to birth outcomes? *J Periodontol.* 2013;84:1327-1336.
6. Hui MY, Longo PL, Bueno-Silva B, Mayer MPA. Mechanisms involved in the association between periodontitis and complications in pregnancy. *Front Public Health.* 2015;2:1-13.
7. Aqueda A, Ramon JM, Manau C, Guerrero MC, Echeverria JJ. Periodontal disease as a risk factor for adverse pregnancy outcomes: A prospective cohort study. *J Clin Peridontol.* 2008;35(1):6-22.
8. American College of Obstetricians and Gynecologists Women's Health Care Physicians; Committee on Health Care for Underserved Women. Committee opinion. Oral health during pregnancy and through the lifespan. *Obstet Gynecol.* 2013;122:417-422.
9. Barak S, Oettinger-Barak O, Oettinger M, Machtei EE, Peled M, Ohel G. Common oral manifestations during pregnancy: a review. *Obstet Gynecol Surv.* 2003;58:624-628.
10. Silk H, Douglass AB, Douglass J M, Silk L. Oral health during pregnancy. *Am Fam Physician.* 2008;77(8):1139-1144.
11. Offenbacher S, Katz V, Fertik G, et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol.* 1996;67(10):1103-1013.
12. Kumar A, Basra M, Begum N, et al. Association of maternal periodontal health with adverse pregnancy outcome. *J Obstet Gynaecol Res.* 2013;39:40-45.
13. Jacob PS, Nath S. Periodontitis among poor rural Indian mothers increases the risk of low birth weight babies: a hospital-based case control study. *J Periodontal Implant Sci.* 2014;44(2):85-93.
14. Li Y, Caufield PW. The fidelity of initial acquisition of mutans streptococci by infants from their mothers. *J Dent Res.* 1995;74:681-685.
15. Chaffee BW, Gansky SA, Weintraub JA, Featherstone JDB, Ramos-Gomez FJ. Maternal oral bacterial levels predict early childhood caries development. *J Dent Res.* 2014;93:238-244.
16. US Department of Health and Human Services. *Oral Health in America: A Report of The Surgeon General.* Rockville, MD: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, 2000.
17. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day, AS, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ.* 2005;83(9):661-665.
18. Vanderbilt AA, Isringhausen KT, VanderWielen LM, Wright MS, Slashcheva LD, Madden MA. Health disparities among highly vulnerable population in the United States: a call to action for medical and dental health care. *Med Educ Online.* 2013;18:1-3.
19. Chung LH, Gregorich SE, Armitage GC, Gonzalez-Vargas J, Adams SH. Sociodemographic disparities and behavioral factors in clinical oral health status during pregnancy. *Community Dent Oral Epidemio.* 2014;42(2):151-159.
20. Detman LA, Cottrell BH, Denis-Luque MF. Exploring dental care misconceptions and barriers in pregnancy. *Birth.* 2010;37:318-324.
21. Lee RSY, Milgrom P, Huebner CE, Conrad DA. Dentist's perceptions of barriers to providing dental care to pregnant women. *Women's Health Issues.* 2010;20(5):359-365.

22. Suri V, Rao NC, Aggarwal N. A study of obstetricians' knowledge, attitudes and practices in oral health and pregnancy. *Educ Health*. 2014:27(1):51-54.
23. Gaffield ML, Gilbert BJ, Malvitz DM, Romaguera R. Oral health during pregnancy: An analysis of information collected by pregnancy risk assessment monitoring system. *J Am Dent Assoc.* 2001;132(7):1009-1016.
24. Kuo LC, Polson, AM, Kang T. Associations between periodontal disease and systemic diseases: A review of the inter-relationships and interactions with diabetes, respiratory diseases, cardiovascular diseases and osteoporosis. *Public Health*. 2008;122:417-433.
25. Jeffcoat MK, Jeffcoat RL, Gladowski PA, Bramson JB, Blum JJ. Impact of periodontal therapy on general health. Evidence from insurance data for five systemic conditions. *Am J Prev Med*. 2014;47(2):166-174.
26. Kawar N, Alrayyes S. Periodontitis in pregnancy: The risk of preterm labor and low birth weight. *Dis Mon*. 2011;57(4):192-202.
27. Murphy VE, Gibson PG. Asthma during pregnancy. *Clin Chest Med.* 2011;32:93-110.
28. Murphy VE, Gibson P, Talbot PI, Clifton VL. Severe asthma exacerbations during pregnancy. *Obstet Gynecol.* 2005;106:1046–1054.
29. Namazy JA, Murphy VE, Powell H, Gibson PG, Chambers C, Schatz M. Effects of asthma severity, exacerbations and oral corticosteroids on perinatal outcomes. *Eur Respir J.* 2013;41:1082-1090.