

Published in final edited form as:

Spec Care Dentist. 2014 January ; 34(1): . doi:10.1111/scd.12014.

Multilevel factors associated with dentists' counseling of pregnant women about periodontal health

Donald L. Chi, DDS, PhD^{*}, Peter Milgrom, DDS^{*}, Adam C. Carle, PhD[#], Colleen E. Huebner, PhD, MPH[^], and Lloyd A. Mancl, PhD^{*}

^{*}University of Washington, School of Dentistry, Department of Oral Health Sciences

[#]University of Cincinnati, School of Medicine, Department of Pediatrics

[^]University of Washington, School of Public Health, Department of Health Services

Abstract

Objective—To identify the factors associated with dentists' counseling of pregnant patients about periodontal health.

Methods—Survey data from Oregon general dentists (N=771) were linked to county-level data from the U.S. Area Resource Files and analyzed using two-level hierarchical linear models.

Results—Dentists who believed there is an important relationship between periodontal disease and adverse pregnancy outcomes counseled significantly larger proportions of pregnant patients ($P<.0001$). Female dentists ($P<.05$) and those who saw a greater number of pregnant patients ($P<.05$) were more likely to counsel. County-level health workforce characteristics (e.g., percent female physicians, obstetricians or gynecologists, female dentists) were not significantly associated with dentists' counseling.

Conclusions—Dentists who were knowledgeable about periodontal disease were more likely to counsel pregnant patients. Future interventions should improve the oral health knowledge of dentists and other healthcare professionals regarding the importance of comprehensive dental care, including periodontal treatment when needed, for all pregnant patients.

Keywords

Dentists practice patterns; counseling; periodontal disease; pregnancy; multilevel analysis

INTRODUCTION

Dentists and other healthcare professionals play a critical role in ensuring that pregnant women have adequate access to dental care and maintain good oral health during pregnancy (1,2). Periodontal counseling during pregnancy is particularly important given the associations between periodontal disease and increased risk of adverse pregnancy-related outcomes such as pre-term birth, low-birth weight, and pre-eclampsia (3). A recent study reported that only one in five Medicaid-enrolled women in Oregon used dental care during pregnancy (4). Another study reported that dentists and obstetricians in Ohio agreed that dental cleanings were safe but disagreed about the safety of periodontal surgery (e.g., scaling and root planing) for pregnant women (5). Collectively, these studies suggest that large proportions of socioeconomically vulnerable pregnant women may not receive

adequate periodontal counseling during pregnancy and that pregnant patients may receive conflicting advice regarding the management of periodontal health during pregnancy.

To address the needs of dentists and other healthcare professionals regarding care for pregnant patients, dental public health leaders have developed evidence-based guidelines for providing anticipatory guidance, counseling, preventive, restorative, and emergency care to pregnant patients (6–8) but adoption of these guidelines by dental healthcare professionals has been slow (9).

A number of studies from medicine have examined the provider- and area-level factors related to variations in the provision of healthcare services (10–13). Individual-level medical provider knowledge and area-level health workforce characteristics, in particular, have been identified as important factors that explain these variations. No such studies to date have been conducted in dentistry, which assumes homogeneity in dentists' behaviors. More specifically, we have no knowledge about the individual dentist-level factors that influence dentists' decision to counsel pregnant patients about periodontal health and how dentists' counseling behaviors differ based on the characteristics of available healthcare professionals in which the dentists practice. To address these critical knowledge gaps, we used multilevel analytic techniques to test three hypotheses: 1) dentists who believe there is an important relationship between periodontal disease and adverse pregnancy outcomes are more likely to counsel pregnant women about periodontal health; 2) individual dentist-level and county-level healthcare workforce characteristics influence counseling behavior; and 3) the relationship between dentists' knowledge and counseling varies across counties.

The knowledge generated from this study is the first step in developing healthcare provider-based interventions and policies that seek to improve the periodontal health of pregnant patients by reducing variations in healthcare provider behaviors that lead to suboptimal patient-level health outcomes.

METHODS

Study Design and Data Sources

This was a secondary data analysis. Data were drawn from two sources. The first was from a survey on dental care for pregnant women sent to all Oregon general dentists identified through the American Dental Association 2006–2007 Master File. The survey was mailed to 1,604 dentists and the completion rate among eligible dentists was 55.2% (829 dentists) (14). The current study focused on 771 of the participants who answered questions about periodontal counseling provided to their pregnant patients. The second data source was the 2007 U.S. Area Resource Files (ARF), which provided the information used to create county-level variables. The county variable associated with each dentist's mailing address was used to link survey and ARF data. The Institutional Review Board of the University of Washington approved the study.

Conceptual Model

The selection of model covariates was based on an oral health disparities model proposed by Patrick and colleagues (15). We included eight dentist-level variables (e.g., demographics, income, practice characteristics) and three county-level variables focusing on characteristics of the healthcare workforce. Each variable is described below.

Outcome Variable

The outcome was the proportion of pregnant patients the dentist reported to have counseled about their periodontal health.

Main Predictor

The main predictor was the dentist's response to the following: "The link between periodontal disease and preterm birth is too tenuous for me to warn my patients". Responses ranged from strongly agree (1) to strongly disagree (5).

Study Variables

The eight dentist-level variables were age (continuous), gender, number of years since receipt of the dental degree (continuous), net income (2005 US dollars) from dentistry (five categories: \$100,000, \$100,001 to \$200,000, \$200,001 to \$300,000, \$300,001 to \$400,000, \$400,001), ownership status (owner/non-owner), proportion of practice comprised of Medicaid-enrolled patients (four categories: 0%, 1% to 19%, 20% to 49%, 50%), and number of pregnant patients seen each month (continuous).

We created three continuous county-level variables that measured the characteristics of the healthcare workforce: the percentage of physicians that were female, the percentage of physicians that were obstetricians or gynecologists, and the percentage of dentists that were female. Each county-level variable was measured in 2007, the year in which the dentist survey was administered.

Analyses

We ran bivariate statistics between the predictor and outcome to assess the linearity assumption, evaluated the normality assumption by examining skewness and kurtosis, and conducted outlier analyses to identify influential cases. The data met all normality assumptions, supporting a linear modeling approach. Five outliers with standardized residuals > 3.0 were identified but were retained in the final models because including the outliers did not significantly change the model coefficients. Two-level hierarchical linear models were used to adjust for clustering of dentists within counties and to assess variation in the relationship between the predictor and outcome across counties (16). We constructed six nested models (listed below) that allowed us to examine the incremental effects of adding variables from various domains to the null model (Model 1).

Model 1: random intercept null model to explore county-level variation in the outcome alone

Model 2: main predictor variable (how strongly the dentist believes that the relationship between periodontal disease and preterm birth is too tenuous to warn patients)

Model 3: Model 2 + age, gender, years since dental degree, income

Model 4: Model 3 + proportion Medicaid and number of pregnant patients.

Model 5: Model 4 + county-level covariates (percent female physicians, obstetricians or gynecologists, female dentists)

Model 6: Model 5 but with the main predictor variable allowed to vary randomly across counties. This model allowed us to test the hypothesis that the relationship between the predictor and outcome varies across counties.

To estimate the dentist-level effect within each county all dentist-level covariates were county-mean (i.e., group-mean) centered and county-level covariates were grand-mean centered (17). The intercept was allowed to vary randomly in all models. All models were fit using SAS 9.3 for Windows (PROC MIXED statement) ($\alpha=0.05$) (16).

RESULTS

Descriptive Statistics

The 771 dentists practiced in 30 of 36 Oregon counties (Table 1). Their mean age was 46.7 years and 82.6% were male. Most incomes ranged \$100,001 to \$200,000 (2005 US dollars). Seventy percent did not own their practice. Nearly 70% of dentists worked in practices that treated no Medicaid-enrolled patients and 6.9% of dentists were in practices that consisted mostly of Medicaid-enrolled patients. The mean proportion of physicians that were female across counties was 30%. At the county-level, the mean proportion of physicians that were obstetricians or gynecologists was 4.6% and the mean proportion of dentists that were female was 9.3%.

Dentists' Counseling Behaviors

The mean proportion of pregnant patients that dentists counseled increased across the five levels of the predictor variable (76.4% to 91.0%). The county mean ranged from a low of 56.3% of patients in Wasco County and a high of 100% in Crook, Grant, Lake, and Wallowa Counties (data not shown).

Hierarchical Linear Regression Models

On average, dentists counseled 84.9% of their pregnant patients about periodontal health (SD=28.2) (Model 1) (Table 2). In models 2 through 5, a one-unit increase in the main predictor variable was associated with a 4.5% to 5.1% increase in the proportion of pregnant patients dentists counseled. Dentists who disagreed that the relationship between periodontal disease and preterm birth is tenuous were more likely to counsel pregnant patients. Regarding other dentist and practice characteristics, female gender, not owning the dental practice, and seeing more pregnant patients all were associated with counseling proportionately more pregnant patients. No county-level variables in Model 5 were significantly associated with counseling. The variance parameter from Model 6 (data not shown) suggests that the relationship between the main predictor and outcome did not vary significantly across counties ($P=.91$).

DISCUSSION

In this study, we tested whether dentists who believed that there is an important relationship between periodontal disease and adverse pregnancy outcomes would counsel proportionately more of their pregnant patients. The first hypothesis was that accurate knowledge would be associated with practice behaviors consistent with professional care guidelines. Our findings are consistent with previous findings (18,19) and support the hypothesis that accurate dentists' knowledge contributes to counseling of more pregnant women.

Our second hypothesis was that other dentist- and county-level factors would be associated with the decision to provide counseling on periodontal health. Three dentist-level factors were associated with greater likelihood of counseling, confirming our hypothesis. Consistent with previous studies, female dentists were more likely to counsel pregnant women than male dentists (20,21). Dentists who saw more pregnant patients were also more likely to counsel, which suggests that increasing exposure to treating pregnant women could be a way to improve dentists' counseling behaviors. In addition, dentists who did not own their practice were more likely to counsel. Previous work has shown that practice owners are more productive than non-owners (14). While increased productivity may allow dentists to see more patients, it may also lead to unintended practice patterns emphasizing restorative procedures at the expense of prevention and counseling. None of the county-level factors

were significant, which suggests that simply increasing the proportions of particular healthcare providers at the county-level may not improve individual dentist-level behaviors. What may be more important is the knowledge these health providers possess. For instance, previous findings suggest that few obstetricians and gynecologists address oral health (22) and that obstetricians and gynecologists may have inadequate knowledge about the safety of periodontal surgery during pregnancy (5). The latter highlights the importance of understanding the knowledge level of both dental and medical providers, which can then form the basis for area-level interventions that target all health professionals in a community who care for pregnant women.

Contrary to our third hypothesis, we found no evidence of variation in the relationship between our predictor and outcome across counties. Based on findings from Model 6, it appears that nearly all the variation was present within counties rather than between counties. These findings suggest that counties may not be the most appropriate unit at which to model variation in the relationship between dentists' knowledge and behaviors. Future studies should explore the extent to which individual-level knowledge and counseling behaviors vary across smaller geographic units such as neighborhoods as well as larger entities such as states.

Although the main strength of this study is the use of a multilevel approach, there are several limitations. First, the data are cross-sectional, which limits our ability to draw causal conclusions. Second, the outcome measure is self-reported and may be susceptible to over reporting because of social desirability bias. Third, the data are from 2006–2007, when state-level guidelines were first introduced. While dentists' counseling behaviors may have changed as a result, recent evidence suggests that this is unlikely (1) given the slow diffusion of scientific knowledge and innovation.

CONCLUSIONS

Overall, our findings support a conceptual model that includes dentist-level factors as potential determinants of dentists' behavior, but in this study we found no evidence that the selected county-level health workforce characteristics were related to dentists' counseling of pregnant patients. Future research should continue to develop multilevel models focusing on knowledge and behaviors of health providers (e.g., obstetricians and gynecologists) as well as dental specialists (e.g., periodontists). The continued dissemination of clinical guidelines may improve provider knowledge and behavior. Interventions and policies should focus on strengthening professional ties between dentistry and relevant medical specialties such as obstetrics and gynecology and standardizing oral health programs for pregnant women across all types of health providers to optimize patient health outcomes.

Acknowledgments

This study was supported by National Institute of Dental and Craniofacial Research (NIDCR) Grant Numbers R03DE021439 and K08DE020856.

References

1. Kloetzel MK, Huebner CE, Milgrom P. Referrals for dental care during pregnancy. *J Midwifery Womens Health*. 2011; 56:110–7. [PubMed: 21429074]
2. Dasanayake AP, Gennaro S, Hendricks-Muñoz KD, Chhun N. Maternal periodontal disease, pregnancy, and neonatal outcomes. *MCN Am J Matern Child Nurs*. 2008; 33:45–9. [PubMed: 18158527]
3. Xiong X, Buekens P, Fraser WD, Beck J, Offenbacher S. Periodontal disease and adverse pregnancy outcomes: a systematic review. *BJOG*. 2006; 113:135–43. [PubMed: 16411989]

4. Milgrom P, Lee RS, Huebner CE, Conrad DA. Medicaid reforms in Oregon and suboptimal utilization of dental care by women of childbearing age. *J Am Dent Assoc.* 2010; 141:688–95. [PubMed: 20516101]
5. Strafford KE, Shellhaas C, Hade EM. Provider and patient perceptions about dental care during pregnancy. *J Matern Fetal Neonatal Med.* 2008; 21:63–71. [PubMed: 18175246]
6. California Dental Association Foundation. [Accessed February 18, 2011] Oral health during pregnancy and early childhood: evidence-based guidelines for health professionals. http://www.cdafoundation.org/library/docs/poh_guidelines.pdf
7. New York State Department of Health. Oral health care during pregnancy and early childhood: practice guidelines. New York State Department of Health; 2006.
8. Oral Health Care During Pregnancy Expert Workgroup. Oral health care during pregnancy: a national consensus statement – summary of an expert workgroup meeting. National Maternal and Child Oral Health Resource Center; Washington, DC: 2012. <http://www.mchoralhealth.org/PDFs/OralHealthPregnancyConsensus.pdf> [Accessed December 7, 2012]
9. Kloetzel MK, Huebner CE, Milgrom P, Littell CT, Eggertsson H. Oral health in pregnancy: educational needs of dental professionals and office staff. *J Public Health Dent.* 2012 Apr 16. [Epub ahead of print].
10. Gifford E, Foster EM. Provider-level effects on psychiatric inpatient length of stay for youth with mental health and substance abuse disorders. *Med Care.* 2008; 46:240–6. [PubMed: 18388838]
11. Carlisle DM, Valdez RB, Shapiro MF, Brook RH. Geographic variation in rates of selected surgical procedures within Los Angeles County. *Health Serv Res.* 1995; 30:27–42. [PubMed: 7721583]
12. Gittelsohn A, Powe NR. Small area variations in health care delivery in Maryland. *Health Serv Res.* 1995; 30:295–317. [PubMed: 7782218]
13. Javitt JC, Kendix M, Tielsch JM, et al. Geographic variation in utilization of cataract surgery. *Med Care.* 1995; 33:90–105. [PubMed: 7823650]
14. Conrad DA, Lee RS, Milgrom P, Huebner CE. Estimating determinants of dentist productivity: new evidence. *J Public Health Dent.* 2010; 70:262–8. [PubMed: 20545830]
15. Patrick DL, Lee RS, Nucci M, Grembowski D, Jolles CZ, Milgrom P. Reducing oral health disparities: a focus on social and cultural determinants. *BMC Oral Health.* 2006; 15:S4. [PubMed: 16934121]
16. Singer J. Using SAS PROC MIXED to fit multilevel models. *J Educ Beh Stat.* 1998; 23:323–35.
17. Enders CK, Tofighi D. Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. *Psychol Methods.* 2007; 12:121–38. [PubMed: 17563168]
18. Lee RS, Milgrom P, Huebner CE, Conrad DA. Dentists' perceptions of barriers to providing dental care to pregnant women. *Women's Health Issues.* 2010; 20:359–65. [PubMed: 20800772]
19. Pina PM, Douglass J. Practices and opinions of Connecticut general dentists regarding dental treatment during pregnancy. *Gen Dent.* 2011; 59:e25–31. [PubMed: 21613028]
20. Brennan DS, Spencer AJ. The role of dentist, practice and patient factors in the provision of dental services. *Community Dent Oral Epidemiol.* 2005; 33:181–95. [PubMed: 15853841]
21. Da Costa EP, Lee JY, Rozier RG, Zeldin L. Dental care for pregnant women: an assessment of North Carolina general dentists. *J Am Dent Assoc.* 2010; 141:986–94. [PubMed: 20675424]
22. Morgan MA, Crall J, Goldenberg RL, Schulkin J. Oral health during pregnancy. *J Matern Fetal Neonatal Med.* 2009; 22:733–9. [PubMed: 19488943]

TABLE 1

Characteristics of Oregon dentists (N=771) and counties (N=30*)

Main Predictor Variable	Dentist-Level Variables	N (%**), Mean \pm SD, or Median
Evidence for link between periodontal disease and preterm birth is too tenuous to warn my patients		
Strongly agree		18 (2.4)
Somewhat agree		75 (9.9)
Neither agree/disagree		205 (27.0)
Somewhat disagree		262 (34.5)
Strongly disagree		199 (26.2)
Age (years)		46.7 \pm 12.0
Gender		
Female		131 (17.4)
Male		623 (82.6)
Years since receipt of dental degree (DDS or DMD)		18.9 \pm 12.4
Net income from dentistry in 2006 (\$)		
\$100,000 or less		186 (26.9)
\$100,001 to \$200,000		288 (41.6)
\$200,001 to \$300,000		126 (18.2)
\$300,001 to \$400,000		46 (6.6)
\$400,001 or more		46 (6.6)
Employment setting		
Owned the dental practice		221 (29.7)
Did not own the dental practice		522 (70.3)
Proportion of practice consisting of Medicaid-enrolled patients		
0%		517 (67.1)

	N (%**), Mean ± SD, or Median
1% to 19%	146 (18.9)
20% to 49%	55 (7.1)
50% or more	53 (6.9)
Number of pregnant patients seen by respondent each month (median)	1.5
County-Level Variables	
% physicians that are female (2007)	29.95 ± 5.40
% physicians that are obstetricians or gynecologists (2007)	4.62 ± 1.13
% dentists that are female (2007)	9.27 ± 4.24

* There are a total of 36 counties in Oregon. For a county to be included in the analyses, there had to be at least one dentist from the county who returned a survey. Six counties (Gilliam, Harney, Jefferson, Morrow, Sherman, and Wheeler) were excluded from the study.

** May not add to 100% because of missing data or rounding

Coefficient estimates and standard errors for covariates in a two-level hierarchical linear model describing the proportion of pregnant patients that dentists provided periodontal counseling in Oregon (N=771 dentists in N=30 counties)

TABLE 2

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	84.9*** (1.0)	85.0*** (1.0)	84.2*** (1.1)	83.8*** (1.2)	83.8*** (1.2)
Main Predictor Variable					
Belief that the link between periodontal disease and preterm birth is tenuous (strongly agree → strongly disagree)		5.2*** (1.0)	4.6*** (1.1)	4.8*** (1.1)	4.9*** (1.2)
Dentist-Level Variables					
Age			-0.1 (0.3)	-0.1 (0.3)	-0.1 (0.3)
Gender (ref=female)			-6.8* (3.1)	-6.8* (3.2)	-6.8* (3.2)
Years since receipt of dental degree			0.1 (0.3)	0.2 (0.3)	0.1 (0.3)
Net income from dentistry			1.0 (1.1)	0.1 (1.2)	0.1 (1.2)
Employment setting (reference=non-owners)			-7.1** (2.7)	-7.2* (3.0)	-7.4* (3.0)
% practice consisting of Medicaid-enrolled patients				-0.1 (0.1)	-0.1 (0.1)
Number of pregnant patients seen each month				0.7* (0.3)	0.7* (0.3)
County-Level Variables					
% female physicians					0.2 (0.3)
% obstetricians and gynecologists					-1.7 (1.0)
% female dentists					0.03 (0.4)

*** P<.0001

** P<.01

* P<.05