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# Child- and State-Level Characteristics Associated with Preventive Dental Care Access Among U.S. Children 5–17 Years of Age

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## Abstract

The objectives of this study is to identify factors associated with lack of preventive dental care among U.S. children and state-level factors that explain variation in preventive dental care access across states. We performed bivariate analyses and multilevel regression analyses among 68,350 children aged 5–17 years using the 2007 National Survey of Children's Health data and relevant state-level data. Odds ratios (ORs) for child- and state-level variables were calculated to estimate associations with preventive dental care. We calculated interval odds ratios (IOR), median odds ratios (MOR), and intraclass correlation coefficients (ICC) to quantify variation in preventive dental care across states. Lack of preventive dental care was associated with various child-level factors. For state-level factors, a higher odds of lack of preventive dental care was associated with

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a higher percentage of Medicaid-enrolled children not receiving dental services (OR = 1.30, 95 % confidence interval (CI): 1.15–1.47); higher percentage of children uninsured (OR = 1.48, 95 % CI: 1.29–1.69); lower dentist-to-population ratio (OR = 1.36, 95 % CI: 1.03–1.80); and lower percentage of dentists submitting Medicaid/State Children's Health Insurance Program claims (OR = 1.04, 95 % CI: 1.01–1.06). IORs for the first three state-level factors did not contain one, indicating that these state-level characteristics were important in understanding variation across states. Lack of preventive dental care varied by state (MOR = 1.40). The state-level variation (ICC = 3.66 %) accounted for a small percentage of child- and state-level variation combined. Child- and state-level characteristics were associated with preventive dental care access among U.S. children aged 5–17 years. State-level factors contribute to variation in dental care access across states and need to be considered in state-level planning.

**Keywords**

Preventive dental care; Multilevel analysis; State-level variation; Children

## Introduction

Good oral health is important for children and an increase in their dental care access is one of the Healthy People (HP) 2020 objectives [1]. The American Academy of Pediatric Dentistry (AAPD) recommends that children should see a dentist every 6 months beginning at age one [2], yet about one in five children in the U.S. does not receive annual dental care [3]. Dental care is the largest unmet health care need among U.S. children [4]. Prevalences of untreated tooth decay have been as high as 16.9 % among children aged 12–15 years and 22.2 % among adolescents aged 16–19 years in 1999–2004 [5].

Traditionally, research has focused on individual-level determinants of dental care among children, such as family income, parental education, race/ethnicity, and dental insurance [6]. However, issues influencing dental care among children are complex and can extend beyond the individual level (e.g., biological and demographic characteristics) to those at the state level (e.g., dental care system characteristics) [6]. Considering factors at all of these levels can provide a more comprehensive understanding of barriers to dental care or dental health. Guay [7] suggested three global factors essential for improving dental care access: effective demand for dental care, an adequate dental work force, and economic environment supporting patients' and providers' participation in assistance programs. A new report by the Pew Center on the States proposed eight proven or promising state policy indicators (Table 1) to ensure dental health and access to care for disadvantaged children. The eight indicators represent areas in prevention including sealants and fluoridation, Medicaid participation, expanding qualified dental providers, and data collection. Two-thirds of the states met only half or fewer of the eight policy benchmarks [8].

Multilevel modeling offers a unique approach to understanding the impacts of individual- and state-level factors on receipt of preventive dental care while simultaneously assessing their contribution to geographic variability in access. Although a wide range of state-level policy issues and dental care system characteristics have been hypothesized to influence

dental care access among children [7, 9, 10], few studies have evaluated these associations among the general population of children while properly accounting for the multilevel structure of the data as well as the complex sampling design [11].

Using 2007 National Survey of Children's Health (NSCH) and relevant available state-level data, we conducted multilevel analyses [11] to identify (1) child- and state-level factors associated with lack of preventive dental care among U.S. children, and (2) state-level factors that explain variation in preventive dental care across states.

## Methods

### Primary Data Source

The NSCH is a telephone survey that provides national and state-level prevalence for various child health indicators and general information about children, family, and neighborhoods in the U.S. [12]. The NSCH was sponsored and conducted by the Maternal and Child Health Bureau of the Health Resources and Services Administration and the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention [12]. Details about sampling design and operation of the NSCH are described elsewhere [12]. We used a public dataset with derived variables provided by the Child and Adolescent Health Measurement Initiative (CAHMI) [13].

### Study Population and Outcome

The 2007 NSCH included a national representative sample of 91,642 children aged 0–17 years. Not receiving preventive dental care such as check-ups and dental cleanings in the past 12 months was the outcome measure, which was collected among children aged 1–17 years who had natural teeth. We limited our analyses to 68,350 children aged 5–17 years. Children 1–4 years of age were not considered in our study due to the following considerations. First, more than half (54.3 %) of children 1–4 years of age did not receive preventive dental care, much higher than the prevalence for children ages 5–17 years. Second, although the American Academy of Pediatrics revised their recommendation to call for a first dental visit at 1 year of age in 2003, the risk and preventive factors influencing dental care were different in the younger age group [14, 15].

### Child-Level Variables

We selected child-level variables which are hypothesized to be associated with preventive dental care based on prior literature and data availability. They are child's gender and race-ethnicity/nativity, the highest education level of either parent, household poverty level, family structure, primary language at home, type of medical insurance, urban/rural residence, mother's perceived physical/mental health status, child's special health care needs status, receiving care that meets medical home criteria, and receiving preventive medical care.

We identified a significant interaction between race-ethnicity and nativity of the child (US-born vs. foreign-born), therefore the present analyses considered race-ethnicity/nativity combined categories. For the 8.5 % of households with missing household income or size,

NCHS multiply imputed data [12]. Household poverty level is expressed as a percentage of household income relative to the U.S. Department of Health and Human Services federal poverty level (FPL) guidelines [12]. The single imputation using the NCHS imputation data file version 3 for income according to the FPL available from the CAHMI dataset was used in this analysis [16].

We classified residence as “urban” or “rural” based on whether or not the child lived in a metropolitan statistical area (MSA). For 16 states in which MSA was suppressed in the public-use file to protect confidentiality, we used procedures recommended by the NCHS to designate MSA status [12].

Care within a “medical home” was based on the AAP definition that includes accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective care, and was estimated per CAHMI guidelines [17].

## State-Level Variables and Their Data Sources

State-level variables were obtained from multiple data sources, and then linked with the NSCH data. Table 1 lists eight state-level policy indicators from the Pew Center report with data collection between 2006 and 2009 [8]. Using the national benchmarks proposed by the Pew Center report, we created a composite score for six policies 1, 2, 3, 6, 7 and 8 that tend to reflect “climate” or “global” policies and might indirectly influence children’s preventive dental care [8]. If the state met the national benchmark for a specific policy, a score of one was assigned; otherwise, zero was assigned. We categorized the composite score into three groups based on its distribution (0–1, 2–3, and 4–5). Policies 4 and 5 were not included in the composite score since they might have “direct” impacts on dental care. Instead, these two policies were assessed individually, with three and four categories respectively using the Pew Report’s suggested cut-off points [8].

Four additional state-level variables obtained from different sources reflected either dental workforce capacity or overall socioeconomic status: ratio of dentists per 10,000 population in 2008 [18], percentage of dentists with Med-icaid/State Children’s Health Insurance Program (SCHIP) claims in 2007 [19], percentage of children under age 18 years without health insurance in 2006–2008 [20], and poverty rate (%) among children under 18 years of age in 2007 [21]. Because there was evidence of a linear dose response between each of these four variables and the outcome, they were used in their continuous form. Data regarding the percentage of dentists with Medicaid/SCHIP claims were not available for three states (Minnesota, Tennessee, and West Virginia), and were coded as missing.

## Statistical Analyses

**Descriptive Analyses—**Chi-square tests were used to assess the differences in the prevalence for lack of preventive dental care across categories of child- and state-level factors. For the four continuous state-level variables, mean, standard deviation, minimum and maximum values were calculated. All descriptive analyses were conducted using SAS-callable SUDAAN [22], accounting for the complex sampling design of the NSCH.

**Multilevel Logistic Regression Analyses—**We used multilevel logistic regression analyses to identify child- and state-level characteristics associated with lack of preventive dental care, and to assess effects of the state-level characteristics on the state-to-state variation in the prevalence of preventive dental care.

The NSCH has a complex sampling design with unequal selection probabilities. Because multilevel model estimation requires special procedures in the presence of design weight, we applied the scaled-weight approach, which provides the least biased estimates in multilevel analyses of complex survey data [11, 23]. The design weights were scaled so that the scaled-weights sum to the effective cluster size [11]. The scaled weight was calculated using methods suggested by Carle [11]. We used Stata's [24] multilevel modeling program, generalized linear and latent mixed models (GLLAMM), using the scaled weights. In the multilevel logistic regression models, we allowed the intercept to vary among states in order to assess the variation in the outcome across states. The following models were used:

**Model 1 (Empty Model):** The empty model did not include any predictor variables and allowed us to assess the overall variation in preventive dental care across states.

**Model 2 (Child-Level Model):** Model 2 included only child-level variables to assess adjusted relationships between child-level factors and preventive dental care and the contribution of the individual factors to the variation in the outcome across states. All child-level variables were candidate variables for Model 2. The non-significant variables were removed sequentially until all variables remaining in the model were significant ($p \leq 0.05$), resulting in the final child-level Model 2.

**Models 3 (Model with Child-Level Variables Plus All Significant State-Level Variables):** Model 3 included all state-level variables and the variables from the finalized Model 2. We also specified a subgroup Model 3 including only those children with Medicaid health insurance to assess whether relationships with the state-level factors specifically measuring Medicaid polices were limited to the Medicaid population. In both the overall and subgroup Model 3, the non-significant state-level variables were removed sequentially, with the final models including all child-level Model 2 variables and significant state-level variables ($p \leq 0.05$). Model 3 estimated the independent relationship between each state-level factor and preventive dental care after controlling for child- and other state-level factors, and also assessed whether preventive dental care access differed across states after controlling for these factors.

We assessed multicollinearity separately among child and state variables. There were no variables with tolerance below 0.4, indicating that multicollinearity was not present [25].

**Estimating Associations Between Child- and State-Level Variables and Preventive Dental Care—**For each multilevel model, we calculated odds ratios (ORs) and 95 % confidence intervals (CIs) for each child- and state-level variable to estimate associations (e.g., commonly called "fixed-effect" in multilevel modeling [26]) with lack of preventive dental care. For four continuous state-level variables, the ORs were calculated for a change of 10 units.

### Understanding Variance in Preventive Dental Care

**Intraclass Correlation Coefficient (ICC):** To estimate the proportion of variance in preventive dental care explained by state relative to the total amount of variance in preventive dental care with state- and child-level variance combined, we used the ICC. We used the latent variable formulation suggested by Merlo et al. [27].

**Median Odds Ratio (MOR):** In an effort to quantify and interpret variance across states with an odds ratio approach, we used the MOR [27]. Essentially, the MOR describes the increased odds of the outcome that would occur if an individual moved from a state with lower odds of the outcome to a state with higher odds of the outcome [27]. As a result, one can compare the MOR across models (e.g., empty model vs. final model) to understand the extent to which variables explain variance in the odds of the outcome across states. For interpretation, the MOR is always equal to or greater than one. If the MOR equals one, no variation exists between states (e.g., the odds of lack of preventive dental care does not differ across states). If the MOR exceeds one, this indicates variation across states [27].

**Interval Odds Ratio (IOR):** The IOR assesses the degree to which each state-level variable explains state-level variation in preventive dental care relative to the residual state-level variation [27]. If the 80 % IOR contains one, the state-level variable does not account for much of the variance in the outcome across states. However, it is worth noting that this does not mean that the state-level variable is an unimportant predictor of preventive dental care [27].

## Results

Our analysis included 68,350 children who were weighted to represent 53,316,846 children ages 5–17 years nationwide. Overall 11.8 % (weighted n = 6,291,388) of U.S. children aged 5–17 years in 2007 did not receive preventive dental care in the previous year (Table 2). The prevalence of lack of preventive dental care was highest among various socio-demographic subpopulations, such as foreign-born minority children, children from families with non-English as the primary language at home, uninsured children, children with low household income, and children whose parents had fewer years of education. No clear dose–response pattern was observed across categories for the three Pew Center policy factors. Table 2 also shows distributions of continuous state-level factors. The values for these indicators varied widely across states. Table 3 presents associations with child- and state-level factors and variance measures across states from multilevel logistic regression models 1, 2 and 3.

### Odds Ratios

Model 2 included child-level variables except for the non-significant variable children's special health care needs (CSHCN) status (Table 3). The patterns of associations between child-level variables and preventive dental care seen in Model 2 remained similar after the addition of significant state factors in Model 3. For the state-level factors, higher odds of lack of preventive dental care was associated with higher state-level percentage of Medicaid-enrolled children not receiving dental services (OR = 1.30, 95 % CI: 1.15–1.47), higher percentage of children uninsured (OR = 1.48, 95 % CI: 1.29–1.69), lower dentist-to-

population ratio (OR = 1.36, 95 % CI: 1.03–1.80), and lower percentage of dentists submitting Medicaid/SCHIP claims (OR = 1.04, 95 % CI: 1.01–1.06). The state-level Pew Center policy 5-Medicaid reimbursement rate, composite score of the six “climate” Pew Center policies, and state-level poverty rate were not significantly associated with preventive dental care.

Model 3, limited to Medicaid-enrolled population, produced generally similar results to those for the overall population. The effect of the dentist-to-population ratio (OR = 0.87, 95 % CI: 0.53–1.44) was weaker and no longer statistically significant in the Medicaid-enrolled population.

### Variance Measures Across States

The MOR in Model 1 was 1.4, indicating that, overall, a child’s odds of lack of preventive dental care varied by state. Thus, if a child moved to a state with a higher probability of lack of preventive dental care, the child’s odds of lack of preventive dental care would increase by 40.00 %. However, only a small percentage (ICC = 3.66 %) of the total variance was explained by state.

The MOR decreased by 9.29 %, from 1.4 in Model 1–1.27 in Model 2, and the state-level variance also decreased by 48.92 % (Table 3), indicating that differences in distributions of the child-level variables across states explained some variance in preventive dental care across states. From Model 2 to Model 3, the MOR decreased by another 11.81 %, from 1.27 to 1.12, and the variance across states decreased by 78.72 %, indicating that the state-level factors explained a larger amount of variance across states compared with the child-level factors. The MOR in Model 3 was still greater than one, indicating that residual heterogeneity across states exists, and the variables considered in this analysis did not fully explain the overall state-level variation in preventive dental care access.

In addition, the IORs for state-level factors including percentage of Medicaid-enrolled children with dental services, dentist-to-population ratio, and percentage of children uninsured did not contain one, indicating that these state-level characteristics were important in understanding variation across states. In contrast, the IOR for percentage of dentists with Medicaid/SCHIP claims contained one, indicating that this state-level factor was less important in explaining the state-level variation.

## Discussion

We found associations between a wide variety of child- and state-level characteristics and preventive dental care among U.S. children 5–17 years of age, along with variation in preventive dental care across states. The cross-state variation in receiving preventive dental care was much smaller than the variation between children. However, several state-level characteristics were identified as important factors in explaining the state-level variation.

For child-level factors, we found significantly higher odds of lack of preventive dental care among foreign-born minority children and children from non-English speaking families. A previous study among U.S. Children aged 1–17 years found similar results for foreign-born

minority children but did not find a significant association with non-English speaking families [28]. It is possible that including younger age children in the study population might dilute the disparity in dental care access. Another study conducted in Canada reported that compared with native-born Canadians, immigrants were more likely to visit dentists for treatment but less likely to visit dentists for preventive care [29]. The reasons and barriers for lack of preventive dental care among foreign-born minority children have not been fully explained. There might be issues regarding lack of knowledge of importance of preventive dental care for children, lack of information about how to access dental care, cultural barriers, and lack of culturally appropriate dental services [28, 30].

We also found children having a preventive medical care visit were more likely to have a preventive dental care visit. One previous study reported a similar finding among Medicaid-enrolled CSHCN [9]. Public perceptions of preventive medical care and dental care may differ, although they are related to each other. Preventive medical care might be a proxy to reflect a family's health care seeking behavior and ability to access services.

We found various state-level characteristics associated with preventive dental care among children. Our study found lower state-level dentist-to-population ratio was significantly associated with lack of preventive dental care among children. Previous studies either did not report a relationship [9, 10] or found dentist shortages in the county related to increased odds of receiving preventive dental care [28]. Dentist supply in the U.S. is influenced by demand, including a sufficient number of people with dental needs who can pay for services [7]. Adequate dentist supply for the overall population may not mean a sufficient number of dentists are participating in public assistance programs such as Medicaid, or that enough dentists are practicing in rural areas [7]. This may explain in part why the dentist-to-population ratio was no longer significant when our analysis was limited to the Medicaid population.

We used the percentage of dentists with Medicaid/SCHIP claims as a surrogate for dentist participation and found lower dentist participation was associated with lack of preventive dental care. A previous study considered this factor as a confounder and did not report its effect on dental care access [10]. For Medicaid-enrolled children, dental services are mandated through the Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) service. However, dentists' low participation in Medicaid has been hypothesized to be a key barrier for improving dental care access [31].

Dentists' reasons for not participating in Medicaid include low reimbursement rates, administrative burdens, and patient behaviors such as no-show appointments [31]. However, similar to a previous study [32], we did not find the reimbursement rate as a significant factor for receiving preventive dental care once dentist participation in Medicaid/SCHIP was taken into account, even when the study was restricted to the Medicaid population. It is possible that the average reimbursement rate for any dental services available in our study may not be as sensitive as the rate specifically for oral prophylaxis. One study found a positive relationship between reimbursement for oral prophylaxis and dental visit among Medicaid-enrolled children [33]. The study measured the impact in the change in Medicaid reimbursement over two time periods instead of measuring the differences across states.

However, this study did not take into consideration a number of other significant state-level factors. Several studies implied raising reimbursement may be necessary but not sufficient to increase access [7, 31, 34].

We found both child health insurance status and a state's percentage of uninsured children were significant factors associated with preventive dental care access. Although these two insurance measures are related to medical care, it has been shown that children without medical insurance are also likely to be without dental insurance [35].

We found that children with lower individual-level household income had increased odds of lack of preventive dental care, while no significant relationship was observed for the state-level poverty rate. A similar relationship with the individual-level income measure has been consistently found in previous studies [9, 10, 28, 36]. One study reported that fair/poor parent-reported oral health for children was associated with lower individual-level income and lower state-level Gini Index [36].

The IORs indicated that state-level factors, such as percentage of children uninsured, dentist-to-population ratio, and percentage of Medicaid-enrolled children receiving dental services, were strong in explaining the between-state variation. These findings support the hypothesis that differences in preventive dental care across states can be explained in part by state-level factors, while highlighting the diversity and complexity of dental care access across states, including differences in the type, number, and coverage of government dental care programs and policies, perceptions of the importance of dental care access, and socioeconomic environment [7, 34, 36].

Our study appears to be the first to estimate independent associations between various child- and state-level characteristics and preventive dental care access among children using the newer suggested methods that properly account for the multilevel structure and complex sampling design of the data [11, 27]. Our study provides estimates of the MOR, IOR, and ICC to quantify the state-level variance in preventive dental care access and relative importance of state-level characteristics in explaining variance. These new measures provide an innovative approach to interpreting state-level variance [27, 37].

Our study is subject to several limitations. A measure of dental insurance is not available in our data. Although dental services are mandated benefits for children enrolled in Medicaid, parents may not be clear about their children's dental coverage. When 2007 data were not available, data from a nearby year were selected for state-level factors, which may not accurately reflect the state context during the NSCH year. These state-level factors generally do not change rapidly over time and therefore data from a nearby year can serve as a viable proxy. Children in three states (Minnesota, Tennessee, and West Virginia) were not included in Model 3 due to the state-level percent of dentists with Medicaid/SCHIP claims not available for these states. The generalizability of this study could be affected slightly by this omission. Because residual between-state heterogeneity still existed in our analyses, additional state-level factors and/or more sensitive measures should be explored. Because many state-level factors such as poverty and dentist supply may vary substantially at the sub-state level, further exploration at smaller geographic units is needed.

The HP 2020 used the Medical Expenditure Panel Survey (MEPS) to estimate annual dental utilization [1]. Among U.S. children 2–17 years of age, the prevalence of lack of preventive dental care (17.5 %) from 2007 NSCH was slightly lower than the prevalence of lack of preventive dental checkups (20.2 %) from 2007 MEPS [38] though data from the two surveys were not completely comparable. The NSCH data were used in this study because the NSCH sampling frame permits better estimation of state level effects and provides access to a larger number of the needed risk and preventive factors.

In conclusion, our study reports independent associations between a wide range of child- and state-level characteristics and preventive dental care access among U.S. children ages 5–17 years using multilevel modeling. Our study reports newer measures that can more specifically capture individual and state-level variation in dental care access. Comprehensive strategies to improve preventive dental care access that combine the traditionally individual-based approach with the approach that emphasizes improvement in identified state-level policies and socioeconomic environment may be needed. The diversity and complexity of these roles should be recognized.

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**Table 1**

Eight state-level policy indicators from the Pew Center report [8]

| | |
|---|---|
| **1** | Percentage of high-risk schools with sealant programs, 2009 |
| **2** | State allows hygienists to provide sealants without a prior dentists' exam, 2009 |
| **3** | Percentage of population on community water supplies with optimally fluoridated water, 2006 |
| **4** | Percentage of Medicaid-enrolled children receiving any dental service, 2007 |
| **5** | Medicaid reimbursement rates as a percentage of dentists' median retail fees, 2008 |
| **6** | Medicaid pays medical staff for early preventive dental health care, 2009 |
| **7** | State has authorized a new primary care dental provider, 2009 |
| **8** | State submits basic screening data to the national database, 2009 |

## Table 2

Weighted prevalence (%) of lack of preventive dental care in the past year by categorical individual- and state-level characteristics and summary descriptions of continuous state-level factors among 68,350 children 5–17 years of age, NSCH (National Survey of Children's Health) 2007

| | Study population percentage (%) | Prevalence (%) | *p* value[a] |
|---|---|---|---|
| Overall | Weighted N = 53,316,846 | 11.8 | |
| Categorical child- and state-level variables | | | |
| *Child-level variables* | | | |
| Sex | | | 0.06 |
| Male | 51 | 12.4 | |
| Female | 48.8 | 11.1 | |
| Race-ethnicity/nativity | | | < 0.001 |
| White, NH, US born | 55.0 | 8.3 | |
| White, NH, foreign born | 0.8 | 6.9 | |
| Black, NH, US born | 14.0 | 13.6 | |
| Black, NH, foreign born | 0.6 | 44.9 | |
| Hispanic, US born | 16.3 | 14.7 | |
| Hispanic, foreign born | 3.1 | 46.5 | |
| Other, US born | 7.5 | 9.7 | |
| Other, foreign born | 0.8 | 20.8 | |
| Primary language at home | | | < 0.001 |
| English | 88.0 | 9.9 | |
| Non-English | 11.9 | 25.5 | |
| Family structure | | | < 0.001 |
| Two parent–biological or adopted | 63.1 | 10.1 | |
| Two parent–step family | 9.7 | 13.6 | |
| Single mother–no father present | 19.8 | 14.1 | |
| Other family type | 7.3 | 18.1 | |
| Number of children in the household | | | 0.1 |
| 1 | 21.7 | 12.7 | |
| ≥2 | 78.3 | 11.5 | |
| MSA | | | 0.04 |
| Inside | 85 | 11.6 | |
| Outside | 15 | 13.1 | |
| Highest education for either parent | | | < 0.001 |
| Less than high school | 9.4 | 25.3 | |
| High school | 23.7 | 15.9 | |
| More than high school | 65.7 | 8.3 | |
| Derived poverty level of household | | | < 0.001 |
| 0–99 % FPL | 17.4 | 21.8 | |
| 100–199 % FPL | 20.8 | 18.7 | |

| | Study population percentage (%) | Prevalence (%) | *p* value[a] |
|---|---|---|---|
| 200–399 % FPL | 31.7 | 9.4 | |
| 400 % FPL or greater | 30.1 | 3.7 | |
| Medical insurance | | | < 0.001 |
| Public, Medicaid, or SCHIP | 26.6 | 13.5 | |
| Private | 62.9 | 7.4 | |
| No insurance | 9.5 | 35.6 | |
| Medical home | | | < 0.001 |
| Yes | 52.2 | 9.4 | |
| No | 43.4 | 14.2 | |
| Preventive medical care | | | < 0.001 |
| Yes | 84.9 | 9.3 | |
| No | 14.3 | 26.4 | |
| CSHCN | | | 0.3 |
| No | 77.6 | 12 | |
| Yes | 22.5 | 11.2 | |
| Mother' physical and mental health conditions | | | < 0.001 |
| Excellent, very good, or good, both conditions | 78.3 | 9.7 | |
| Fair or poor, one or both conditions | 14.3 | 20.1 | |
| Mother not in the household | 7.2 | 18.2 | |
| *State-level variables* | | | |
| "Direct" Pew Center policy indicators 4 and 5 | | | |
| Policy 4. Percentage of Medicaid children receiving any dental service, 2007 | | | < 0.001 |
| < 30 % | 13.1 | 15.6 | |
| 30–38 % | 36.1 | 10.5 | |
| > 38 % | 50.8 | 11.7 | |
| Policy 5. Medicaid reimbursement rates as a percentage of dentists' median retail fees, 2008 | | | < 0.001 |
| < 50 % | 37.3 | 12.6 | |
| 50–60.4 % | 18.6 | 9.3 | |
| 60.5–69.9 % | 18.7 | 10.2 | |
| ≥70 % | 25.4 | 13.6 | |
| "Climate" Pew Center policies (policies 1–3, 6–8)—composite score[b] | | | 0.04 |
| 0 or 1 | 9.8 | 11.6 | |
| 2 or 3 | 48.3 | 12.7 | |
| 4 or 5 | 42.0 | 10.8 | |

**Continuous state-level variables**

| | Number | Mean | Standard deviation | Minimum–Maximum |
|---|---|---|---|---|
| Dentists per 10,000 population, 2008 | 51 | 7.4 | 1.9 | 5–15 |
| Percent of dentists with Medicaid/SCHIP claim(s), 2007[c] | 48 | 44.1 | 23.2 | 7.2–91.8 |
| Percent of children 0–18 years uninsured, 2006–2008 | 51 | 9.5 | 3.7 | 4.5–20.8 |
| Percent of children < 18 years in poverty, 2007 | 51 | 17.4 | 4.8 | 9.2–29.4 |

*MSA* metropolitan statistical area, *FPL* federal poverty level, *SCHIP* State Children's Health Insurance Program, *CSHCN* children with special health care needs

[a] *p* value based on Chi-square test

[b] A composite score was created by using the national benchmark for each of the six policy indicators proposed by the Pew Center report [6]. If the state met the national benchmark for a specific policy, a score of one was assigned; otherwise, zero was assigned

[c] Based on 48 states with available data

## Table 3

Adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) for child- and state-level variables in relation to lack of preventive dental care and measures of state-level variation obtained from multilevel logistic regression models 1[a], 2[b], and 3[c], children 5–17 years of age, NSCH (National Survey of Children's Health) 2007

| | Model 2 (with child-level variables) | | | Model 3 (with child- and state-level variables) | | | | |
|---|---|---|---|---|---|---|---|---|
| | OR | 95 % CI | *p* value[d] | OR | 95 % CI | *p* value | Lower 80 % IOR[b] | Upper 80 % IOR |
| *Child-level variables* | | | | | | | | |
| Sex | | | | | | | | |
| Male | 1.11 | 1.01–1.23 | 0.04 | 1.13 | 1.02–1.25 | 0.02 | | |
| Female | 1.00 | | | 1.00 | | | | |
| Race-ethnicity/nativity | | | | | | | | |
| White, NH, US born | 1.00 | | | 1.00 | | | | |
| White, NH, foreign born | 1.10 | 0.69–1.76 | 0.68 | 1.06 | 0.65–1.71 | 0.83 | | |
| Black, NH, US born | 1.23 | 1.07–1.41 | 0.003 | 1.20 | 1.03–1.40 | 0.02 | | |
| Black, NH, foreign born | 2.89 | 1.75–4.78 | < 0.001 | 2.90 | 1.74–4.82 | < 0.001 | | |
| Hispanic, US born | 0.99 | 0.86–1.14 | 0.89 | 0.97 | 0.84–1.12 | 0.65 | | |
| Hispanic, foreign born | 1.85 | 1.39–2.46 | < 0.001 | 1.86 | 1.40–2.47 | < 0.001 | | |
| Other, US born | 1.21 | 1.00–1.46 | 0.05 | 1.13 | 0.95–1.33 | 0.16 | | |
| Other, foreign born | 2.89 | 1.93–4.31 | < 0.001 | 3.08 | 2.06–4.60 | < 0.001 | | |
| Primary language at home | | | | | | | | |
| English | 1.00 | | | 1.00 | | | | |
| Non-English | 1.30 | 1.06–1.59 | 0.01 | 1.21 | 1.01–1.46 | 0.04 | | |
| Family structure | | | | | | | | |
| Two parent—biological or adopted | 1.00 | | | 1.00 | | | | |
| Two parent—step family | 1.20 | 1.03–1.40 | 0.02 | 1.14 | 0.98–1.32 | 0.09 | | |
| Single mother—no father present | 1.04 | 0.92–1.18 | 0.53 | 1.02 | 0.89–1.16 | 0.80 | | |
| Other family type | 1.46 | 0.94–2.26 | 0.09 | 1.50 | 0.95–2.36 | 0.08 | | |
| Number of kids in household | | | | | | | | |
| One child | 1.25 | 1.17–1.34 | < 0.001 | 1.27 | 1.18–1.36 | < 0.001 | | |
| Two or more children | 1.00 | | | 1.00 | | | | |
| MSA | | | | | | | | |

| | Model 2 (with child-level variables) | | | Model 3 (with child- and state-level variables) | | | | |
|---|---|---|---|---|---|---|---|---|
| | OR | 95 % CI | *p* value[d] | OR | 95 % CI | *p* value | Lower 80 % IOR[b] | Upper 80 % IOR |
| Inside | 1.00 | | | 1.00 | | | | |
| Outside | 1.17 | 1.01–1.35 | 0.04 | 1.20 | 1.04–1.39 | 0.01 | | |
| Highest education level of either parent | | | | | | | | |
| Less than high school | 1.54 | 1.30–1.83 | < 0.001 | 1.57 | 1.32–1.86 | < 0.001 | | |
| High school | 1.22 | 1.10–1.35 | < 0.001 | 1.22 | 1.09–1.36 | < 0.001 | | |
| More than high school | 1.00 | | | 1.00 | | | | |
| Derived household poverty level | | | | | | | | |
| 0–199 % FPL | 3.75 | 3.33–4.21 | < 0.001 | 3.80 | 3.38–4.27 | < 0.001 | | |
| 200–399 % FPL | 2.27 | 2.05–2.50 | < 0.001 | 2.25 | 2.04–2.48 | < 0.001 | | |
| ≥400 % FPL | 1.00 | | | 1.00 | | | | |
| Medical insurance | | | | | | | | |
| Private insurance | 1.00 | | | 1.00 | | | | |
| Medicaid/SCHIP[b] | 0.98 | 0.87–1.09 | 0.66 | 0.98 | 0.87–1.10 | 0.71 | | |
| No insurance | 2.63 | 2.30–3.00 | < 0.001 | 2.70 | 2.36–3.09 | < 0.001 | | |
| Medical home | | | | | | | | |
| Yes | 1.00 | | | 1.00 | | | | |
| No | 0.92 | 0.85–1.00 | 0.05 | 0.91 | 0.84–0.99 | 0.03 | | |
| Preventive medical care | | | | | | | | |
| Yes | 1.00 | | | 1.00 | | | | |
| No | 2.81 | 2.54–3.11 | < 0.001 | 2.78 | 2.50–3.09 | < 0.001 | | |
| Mother’s physical and mental health conditions | | | | | | | | |
| Both excellent, very good, or good | 1.00 | | | 1.00 | | | | |
| One or both fair or poor | 1.54 | 1.38–1.73 | < 0.001 | 1.55 | 1.37–1.75 | < 0.001 | | |
| Mother not in the household | 1.05 | 0.69–1.59 | 0.83 | 1.00 | 0.65–1.55 | 0.99 | | |
| *State-level variables* | | | | | | | | |
| Pew Policy 4. Percentage of Medicaid children receiving any dental service, 2007 | | | | | | | | |
| < 30 % | | | | 1.30 | 1.15–1.47 | < 0.001 | 1.05 | 1.61 |
| 30–38 % | | | | 1.17 | 1.04–1.33 | 0.01 | 0.95 | 1.45 |
| > 38 % | | | | 1.00 | | | | |

| | Model 2 (with child-level variables) | | | Model 3 (with child- and state-level variables) | | | | |
|---|---|---|---|---|---|---|---|---|
| | **OR** | **95 % CI** | ***p* value**[d] | **OR** | **95 % CI** | ***p* value** | **Lower 80 % IOR**[b] | **Upper 80 % IOR** |
| Dentists per 10,000 population (decrease of 10 per 10,000) | | | | 1.36 | 1.03–1.80 | 0.03 | 1.10 | 1.68 |
| Percent of dentists with Medicaid/SCHIP claim(s), 2007 (decrease of 10 %) | | | | 1.04 | 1.01–1.06 | 0.01 | 0.84 | 1.28 |
| Percent of children 0–18 uninsured, 2006–2008 (increase of 10 %) | | | | 1.48 | 1.29–1.69 | < 0.001 | 1.19 | 1.82 |
| Variance | | | | | | | | |
| State-level variance (standard error)[a] | 0.0639 (0.0198) | | | 0.0136 (0.0077) | | | | |
| ICC[a] | 1.91 % | | | 0.41 % | | | | |
| MOR[a] | 1.27 | | | 1.12 | | | | |

*MSA* metropolitan statistical area, *FPL* federal poverty level, *SCHIP* State Children's Health Insurance Program, ICC intraclass correlation coefficient, *MOR* median odds ratio, IOR interval odds ratio

[a] Model 1 (Empty Model): n = 68,350; State level variance (Standard Error) = 0.1251 (0.0302); MOR = 1.40; ICC = 3.66 %

[b] Model 2 was conducted among 63,506 children with complete data on child-level variables in Model 2

[c] Model 3 was conducted among 59,785 children with complete data on child- and state-level variables in Model 3. Percent of dentists with Medicaid/SCHIP claims was not available in three states (Minnesota, Tennessee, and West Virginia). Therefore, children in these states were not included in Model 3

[d] *p* value derived from the multilevel logistic regression model