# The Effect of Insurance Coverage on Tennessee Children's Receipt of Preventive Dental Services and Oral Health

Allison Thigpen

A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington

2014

Committee:

Aaron Katz, Chair

Nathan Tefft

Program Authorized to Offer Degree:

Health Services

University of Washington

## Abstract

The Effect of Insurance Coverage on Tennessee Children's
Receipt of Preventive Dental Services and Oral Health

Allison Thigpen
Chair of the Supervisory Committee:
Principal Lecturer, Aaron Katz
Health Services

**BACKGROUND:** This capstone has two parts – a policy brief and a secondary data analysis. The policy brief explains the importance of children's dental care and presents five policy recommendations to increase access to preventive dental care among children in Tennessee. The data analysis examines associations between parents' report of source of insurance, receipt of preventive dental services, and oral health.

**METHODS:** This study performs a cross-sectional analysis using data from the 2011 National Survey of Children's Health. Data were divided into two samples: national (n=87,720) and Tennessee (n=1,752). Logistic regression, ordinary least squares regression, and chi-squared tests were used to estimate associations between source of insurance, receipt of preventive dental services, and self-reported oral health. Results from each sample were compared.

**RESULTS:** The National and Tennessee samples had similar rates of insurance coverage, receipt of preventive dental care, and self-reported oral health status. Public (US: OR=3.92; TN: OR=1.98) and private insurance (US: OR=3.54; TN: OR=2.13) were associated with preventive dental care in both samples. The difference between mean oral health status between those with private insurance and those with no insurance changes from 1.12 (TN: 0.48) in the unadjusted model to 0.24 (TN: 0.1) in the adjusted model.

**CONCLUSION:** While insurance is correlated with receipt of preventive *dental* care, a causative relationship is questionable. Those with insurance have a greater likelihood of receiving preventive dental services, but the exact mechanism of this relationship is unknown. The role of insurance on receipt of preventive dental services seems to be less influential in Tennessee than nationally**.** The correlation between source of insurance and oral health status is largely mediated through covariates.

# Table of Contents

# List of Tables and Figures

# PREVENTING DENTAL CARE IN TENNESSEE

## Expanding Access to Preventive Dental Care

February 8, 2014

**RECOMMENDATIONS:**

**To improve access to covered dental care services for children ages 1-21 under the Medicaid EPSDT benefit, Tennessee should:**

1. Invest in outreach efforts to enroll more eligible children in TennCare.
2. Support DentaQuest USA Insurance Co. Inc. in providing accessible dental care through a robust provider network.
3. Allow allied dental professionals to practice to the full extent of their education and training.
4. Support the integration of dental practices into Federally Qualified Health Centers (FQHCs).
5. Coordinate with Head Start programs to promote oral health by educating families about the importance of caring for their teeth and covered TennDent services.

Dental care often seems like a vanity service available only for those who can afford these procedures. Teeth cleaning, whitening, and braces all address cosmetic issues. Dental care, however, can both prevent and treat serious medical conditions that affect the mouth as well as the rest of the body. As such, investments in prevention can have both medical and financial benefits for Tennessee.

Dental caries, more commonly known as tooth decay, are the most common childhood disease, affecting 80% of children during their adolescence. [1] In fact, dental caries occur five times as frequently as asthma, the second most common chronic disease in children.[2]

Dental caries are caused by contagious bacteria.[3] Cavities, or holes in teeth, provide cozy environments for these bacteria to flourish, and sugary foods provide nourishment for them.

Fortunately, dental caries are preventable and easily treated if caught early.[4] Dental offices provide two primary treatments to prevent dental caries. First, dental sealants fill in cavities which limit places for these bacteria to settle. Second, fluoride varnishes provides a protective film for teeth.

Many children do not receive the medical attention necessary to either prevent cavities or to treat them before they become serious medical conditions.[5, 6] Left untreated, cavities can fester into toothaches requiring antibiotics and even tooth extraction. Often, these children receive this care in emergency rooms rather than dentist offices.

**Causes of dental caries**

Dental caries are caused by a type of bacteria called *Streptococcus mutans* that chemically changes certain foods into corrosive acids.[7] These acids demineralize (eat away at) teeth, causing tooth decay and create cavities. This decay can lead to severe pain that affects which foods can be eaten. Teeth can crack under the pressure of certain foods. Ultimately, if left untreated, severe deterioration may require tooth extraction which may require surgery and anesthesia. Additionally, the bacteria may spread to other organ systems; cases of *Streptococcus mutans* have resulted in brain abscesses.[8]

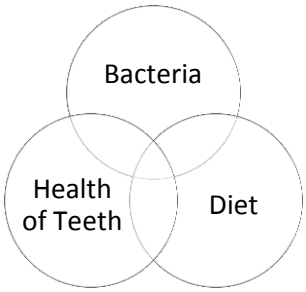


**Figure 1:** Factors in dental health (Adapted from Fischer-Owens)

Unhealthy teeth, a sugary diet, and presence of bacteria must align to create the conditions necessary for dental caries to develop or progress (See Figure 1).[9] Unhealthy teeth provide an environment for bacteria to flourish. Diets high in sugar provide food for the bacteria to convert to acids. Personal hygiene practices like teeth brushing can eliminate these foods and manage bacteria populations; these measures by themselves, however, are not sufficient to eliminate dental caries.

**Consequences of dental caries[10]**

The consequences of untreated dental caries are costly.

When families do not have access to dental care, dental caries go untreated. When decaying teeth start to hurt, families access care through emergency departments. [11, 12] Nevertheless, emergency

departments are not equipped to handle oral health problem and only use stop-gap measures to treat the issue. Patients must subsequently visit a dentist for a long-term solution. Moreover, the costs of visiting an emergency department are substantially higher than the cost to treat dental caries in a dental office.

Treating dental caries in hospitals incurs large costs from use of general anesthesia, antibiotics, analgesics, and hospital admission. Millions of dollars are spent each year to treat a largely preventable disease.[13]

In addition to direct hospital costs, dental caries result in other hardships on children and families:

- Missed days from school resulting in loss of academic performance
- Loss of work time and employment for the parents[14]

Furthermore, the bacteria can spread to other parts of the body and has been found in brain abscesses. Rare cases have been reported of deaths due to these bacterial infections.

**RECOMMENDATIONS:**

Even though Medicaid covers preventive, diagnostic, and therapeutic dental services through the EPSDT benefit, only 40% of children enrolled in Medicaid receive preventive dental services each year.[15] The Centers for Medicare and Medicaid Services (CMS) has identified several barriers to accessing dental care: limited availability of dental providers, lack of clear information for beneficiaries about dental benefits, transportation, and the need for consumer education about the benefits of dental care (CMS April 2011).

**To improve access to covered dental care services for children ages 1-21 under the Medicaid EPSDT benefit, Tennessee should:**

1. Invest in outreach efforts to enroll more eligible children in TennCare.
2. Support DentaQuest USA Insurance Co. Inc. in providing accessible dental care through a robust provider network.
3. Allow allied dental professionals to practice to the full extent of their education and training.
4. Support the integration of dental practices into Federally Qualified Health Centers (FQHCs).
5. Coordinate with Head Start programs to promote oral health by educating families about the importance of caring for their teeth and covered TennDent services.

**RECOMMENDATION 1:**

**Invest in outreach efforts to enroll more eligible children in TennCare.**

**Dental health coverage removes financial barriers that keep children from receiving preventive dental care.** Consequently, children and youth with insurance are more likely to receive a preventive dental visit than those with no insurance.[18, 19, 20] Likewise, children enrolled in Medicaid are more likely to receive dental preventive services; In Tennessee in 2011, 40% of children on Medicaid receive preventive dental care as compared with only 30% of all children

(See Table 2).

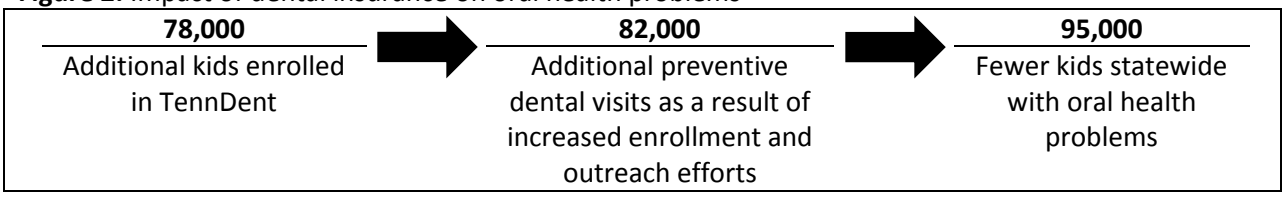
**Table 1: Receipt of Dental Preventive Services, 2011.**

| More children enrolled in Medicaid received preventive dental services in 2011. [16, 17] | | |
|---|---|---|
| | **Medicaid** | **All children** |
| **Tennessee** | **40%** *(359,900)* | **30%** *(464,000)* |
| **United States** | **37%** *(13,074,500)* | **32%** *(25,003,000)* |

When more children enroll in TennCare and receive preventive health services, oral health does improve. Consider the following:

- TennCare enrollment increased from 2008 to 2011 by 10% resulting in an additional 78,000 kids with dental coverage in 2011.[21]
- In addition, the proportion of kids receiving preventive dental care increased from 2007 to 2011 from 34% to 40% resulting in an additional 82,000 kids receiving preventive services in 2011.[22]
- **As a result, we saw 95,000 fewer kids statewide with oral health problems in 2011.[23]**

**Figure 2:** Impact of dental insurance on oral health problems



**RECOMMENDATION 2:**

**Support DentaQuest USA Insurance Co. Inc. in providing accessible dental care through a robust provider network.**

**The goal of this and the next policy recommendations is to increase the number of dental providers available to children on Medicaid.** While the state has increased the number of children who receive preventive services, only 40% of children enrolled in Medicaid in 2011 received preventive dental services. [24, 25, 26] Additionally, in 2011, 273,000 children still had one or more oral health problem. While Tennessee does slightly better than the national average, the state still incurs the additional costs of treating preventable dental caries.

One out of five Tennesseans lives in a dental professional shortage area which makes it difficult for many to find an available appointment within a reasonable distance. [27] Tennessee ranks 43rd in the number of people living in one of these dental shortage areas.

In Tennessee, Medicaid Dental benefits are managed by DentaQuest USA Insurance Company, Inc. with minimal oversight from the TennCare office.[28] Under the TennCare contract, DentaQuest must provide accessible care through a sufficient network of dental providers. Medicaid enrollees should not have waiting time exceeding three weeks for an appointment or 48 hours for an emergency. Additionally, network dental providers must be available within an average of 30 miles, with exceptions for rural communities. DentaQuest cannot refuse a qualified provider in a service area with enrollees traveling beyond the 30 mile standard.

Beyond these basic requirements, DentaQuest should be encouraged to add additional providers, particularly in shortage areas, to ensure access to care.

**RECOMMENDATION 3:**

**Allow allied dental professionals to practice to the full extent of their education and training.**

Dental hygienists are mid-level dental providers who must practice under the supervision of a dentist. According to the Bureau of Labor Statistics, "Dental hygienists clean teeth, examine patients for oral diseases such as gingivitis, and provide other preventative dental care. They also educate patients on ways to improve and maintain good oral health."[29] These professionals can apply dental sealants after a dental exam and under general supervision from a dentist.[30]

States determine the "scope of practice," or the services a dental professional may provide, through licensure laws. Historically, many states, including Tennessee, have limited the scope of practice for

dental hygienists under the assumption that these professionals provide less effective and less safe care due to their limited training.

This assumption, however, proves false. Studies show that "restrictive licensure laws in oral health are not tied to better health outcomes."[31] In other words, limiting the scope of practice for a dental hygienist does not protect the public but rather restricts access to dental care in two ways: 1. Increased consumer costs and 2. Reduced workforce.

Other states are expanding the autonomy of dental hygienists and reimbursing them directly through Medicaid. Forty states allow dental hygienists "direct access" which allows them to initiate and treat a patient without the presence of a dentist.[32] As of October 2012, fifteen states allow their Medicaid programs to reimburse dental hygienists directly instead of paying a supervising dentist.[33]

Restrictive licensure laws do lead to increased income for dentists and fewer employment opportunities for dental hygienists. Allowing dental hygienists to practice at the top of their training provides would allow Medicaid dollars to reach more children.

**RECOMMENDATION 4:**

**Support the integration of dental practices into Federally Qualified Health Centers (FQHCs).**

*One out of five Tennesseans lives in a dental professional shortage area.*

Tennessee has 23 Federally Qualified Health Centers (FQHCs) that serve Federally-designated Medically Underserved Areas/Populations.[34] These clinics have experience working with low-income populations who benefit from the integration of primary care and dental services. Integration is "when oral health works within primary care. In this case, patients perceive that they are receiving dental services that are a routine part of their health care."[35]

Integration would increase the appropriate use of dental care. In addition, proximity to their primary care provider would reduce transportation and time barriers. For example, dental visits could be scheduled concurrently with primary care visits, thus reducing time off work and out of school and ensuring that the dental visit is scheduled and used. These locations would expand the entry points into the dental care system, especially for underserved populations.

In addition to improving access to dental care for children, integration would have benefits for adult medical and dental care.[36] Research indicates that oral health and medical health are interrelated. For example, periodontal disease is a warning sign for vascular disease. Thus, by improving the effectiveness and efficiency of both medical and dental, integration may reduce both preventable medical and dental conditions. Consequently, cost savings to health care system as a whole could be achieved by controlling dental disease and other chronic diseases like diabetes.

**RECOMMENDATION 5:**

**Coordinate with Head Start programs to promote oral health by educating families about the importance of caring for their teeth and covered TennDent services.**

The public has little knowledge about how to prevent oral health disease.[37] In national surveys, respondents did not know that dental caries were transmissible (contagious) or the role of dental sealants and fluoride. Consequently, CMS has identified the need for consumer education about the benefits of dental care.[38]

Education is important in motivating parents to ensure that their children are receiving dental care.

**CONCLUSIONS**

Tennessee has improved children's oral health over the past five years but still has room to advance. Efforts to improve access to dental coverage and dental services have proven benefits for reducing oral health problems.

Written by Allison Thigpen, MPHc at the University of Washington in coordination with the Tennessee Primary Care Association (TPCA). Special thanks to Aaron Katz and Dr. Nathan Tefft for their guidance.

## Policy Brief Citations


[1] Mouradian WE, Wehr E, Crall JJ. 2000. Prevalence, Etiology, and Prevention of Childhood Caries. Journal of the Canadian Dental Assoication. http://jama.jamanetwork.com/article.aspx?articleid=193312.

[2] Ibid 1

National Healthcare Disparities Report, 2011. Agency for Healthcare Research and Quality (ARHQ) AHRQ Publication No. 12-0006. March 2012 www.ahrq.gov/qual/qrdr11.htm, 87.

[3] Ibid 1

[4] Ibid 1

[5] 17.4% of Tennessee children ages 1-17 had one or more oral health problem when surveyed in 2011.

[6] The Kaiser Family Foundation State Health Facts. Data Source: Child and Adolescent Health Measurement Initiative. 2011 National Survey of Children's Health, Data Resource Center for Child and Adolescent Health website. Retrieved June 2013.

[7] Ibid 1

[8] Ibid 1.

[9] Ibid 1.

[10] IOM (Institute of Medicine) and NRC (National Research Council). 2011. Improving access to oral health care for vulnerable and underserved populations. Washington, DC: The National Academies Press. p. 19.

[11] Cohen, LA. Bonito AJ. Eicheldinger C. et al. Comparison of patient visits to emergency departments, physician offices, and dental offices for dental problems and injuries. Journal of Public Health Dentistry, 71 (2011) 13-22.

[12] Davis, EE. Deinard, AS. Maïga, EW. Doctor, my tooth hurts: the costs of incomplete dental care in the emergency room. Journal of Public Health Dentistry. 70 (2010) 205–210.

[13] Casamassimo, P. Silverman, J. 2009. Technical Report 1-2012: Considerations for Caries-Risk Assessment in an Essential Health Benefits Dental Plan for Children. Pediatric Oral Health Research and Policy Center. Casamassimo, PS. Thikkurissy, S. Edelstein, BL. Maiorini, E. Beyond the dmft: The Human and Economic Cost of Early Childhood Caries. JADA 2009;140(6):650-657.

[14] Gift, H. Reisine, ST. Larach DC. The social impact of dental problems and visits. Am J Public Health. 1992; 82: 1663-1668.

[15] CMS-416 Form EPSDT 2011 Reports. Author Calculations.

[16] Table shows receipt of dental preventive services for children (ages 1-17).

[17] The Kaiser Family Foundation State Health Facts. Data Source: Child and Adolescent Health Measurement Initiative. 2011 National Survey of Children's Health, Data Resource Center for Child and Adolescent Health website. Retrieved June 2013. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey (CPS: Annual Social and Economic Supplements). CMS-416 Form EPSDT 2011 Reports. Author Calculations.

[18] Bell JF, Huebner CE, Reed, SC. Oral Health Need and Access to Dental Services: Evidence from the National Survey of Children's Health, 2007. Matern Child Health J (2012) 16:S27-S34;

[19] Huebner CE, Bell JF, Reed SC. Receipt of Preventive Oral Health Care by U.S. Children: A Population-Based Study of the 2005-2008 Medical Expenditure Panel Surveys. Matern Child Health J. 2012 Oct 20.

[20] Romaire, MA. Bell, JF. Huebner CE. Variations in Children's Dental Service Use Based on Four National Health Surveys. Pediatrics 2012;130;e1182; originally published online October 15, 2012.

[21] CMS-416 Form EPSDT 2011 Reports. Author Calculations.

[22] Ibid 17.

[23] The Kaiser Family Foundation State Health Facts. Data Source: Child and Adolescent Health Measurement Initiative. 2011 National Survey of Children's Health, Data Resource Center for Child and Adolescent Health website. Retrieved June 2013.

[24] CMS-416 Form EPSDT 2011 Reports. Author Calculations.

[25] A Costly Dental Destination: Hospital Care Means States Pay Dearly. Pew Children's Dental Campaign Issue Brief. The Pew Center on the States. 2012.

[26] Ibid 1.

[27] In Search of Dental Care Two Types of Dentist Shortages Limit Children's Access to Care. The Pew Center on the States. June 2013. http://www.pewstates.org/uploadedFiles/PCS_Assets/2013/In_search_of_dental_care.pdf
[28] TennCare Dental Administrative and Management Services. Contract with DentaQuest USA Insurance Co., Inc. Valid May 15, 2013 - September 30, 2016. Agency Tracking #: 31865-00355.
[29] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2012-13 Edition, Dental Hygienists, on the Internet at http://www.bls.gov/ooh/healthcare/dental-hygienists.htm (visited October 15, 2013).
[30] Sealant Application: Settings and Supervision Levels by State. American Dental Hygienists Association. September 2013. http://www.adha.org/resources-docs/7518_Sealant_Application_Setting_Supervision_by_State.pdf
http://www.adha.org/resources-docs/7518_Sealant_Application_Setting_Supervision_by_State.pdf
[31] IOM (Institute of Medicine). 2011. Advancing Oral Health in America. Washington, DC: The National Academies Press. p. 118 via IOM, 1989; Kleiner and Kudrle, 2000; Shepard, 1978 via IOM report
[32] Direct Access to Care from DH (Dentist Hygenists). Prepared by the staff of the American Dental Hygienists' Association, October 2012. http://www.adha.org/resources-docs/7513_Direct_Access_to_Care_from_DH.pdf
[33] States Which Directly Reimburse Dental Hygienists for Services under the Medicaid Program. Prepared by staff of the American Dental Hygienists' Association, June 2010. http://www.adha.org/resources-docs/7519_Direct_Reimbursement_Medicaid_by_State.pdf. IOM report via ADHA, 2010c
[34] National Association of Community Health Centers, Incorporated (NACHC) analysis of the 2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, Department of Health and Human Services, Special Data Request, March 2013.
[35] Returning to the Body: Integrating Oral Health and Primary Care. Grant Makers in Health. Issue Brief No. 40. September 2012. Collins et al 2010 via GMH
[36] Ibid 32
[37] Ibid 28. p. 55
[38] Improving Access to and Utilization of Oral Health Services for Children in Medicaid and CHIP Programs: CMS ORAL HEALTH STRATEGY. April 11, 2011.

# Part II: Data Analysis

**INTRODUCTION**

Estimates of the proportion of children nationally who receive preventive dental visits annually vary widely from 21%-78%. [1, 2, 3 4] These estimates come from a range of surveys -- Medical Expenditure Panel Survey (MEPS), the National Survey of Children's Health (NSCH), and the National Survey of America's Family (NSAF) – that employ different sampling and survey methods that could account for disparate assessments.[5] More specifically, despite the fact that Medicaid covers dental services for children, data from the Department of Health and Human Services suggests that only 38% of children enrolled in Medicaid in 2011 received preventive dental services, up from 20% in 1996.[6, 7, 8]

Literature suggests that children and youth with private or public insurance are more likely to receive a preventive dental visit than those with no insurance.[9, 10, 11] One study on (non-dental) well-child visits suggests that children enrolled in public insurance programs receive more care than children enrolled in private insurance programs or children without insurance.[12] Determining the effectiveness of the Medicaid program in improving access to preventive dental services for children, however, is a more difficult question. Few studies compare Medicaid-eligible children who are and who are not enrolled in the Medicaid program. In one example, Fischer and Mascarenhas did not find a statistically significant difference in access to services, health status, or oral health need between eligible children enrolled in Medicaid and uninsured children when controlling for confounding variables.[13]

One explanation for this ambiguous result may be the difference in Medicaid programs over time and across states. Medicaid programs continually change as legislators and program directors alter the structure and incentives in the respective programs. Some policies may result in improved access to health services. For example, Fischer and Mascarenhas note that dentists' participation in Medicaid

programs has improved since their study period as a result of increased reimbursements.[14] Literature shows that changes in reimbursement levels, premiums and copays, incentives, and delivery systems can improve receipt of preventive services.[15] As such, the successes of well-designed Medicaid programs may be muted in national datasets by poorly designed programs.

These mutable Medicaid policies that make a considerable impact on the effectiveness of these programs vary substantially among states. Eligibility levels range from 133% of Federal Poverty Level (FPL) in states like Arkansas, Alabama, and Louisiana to 275% FPL in Minnesota.[16] Application and enrollment procedures differ, resulting in varying proportions of the eligible population enrolled in each state's program. Some states have premiums and co-pays for their Medicaid programs. Finally, provider networks, or providers that accept Medicaid, will depend on the restrictions defined by specific states, and will depend largely on disparate reimbursement levels. Moreover, since states cannot run a deficit, states are more sensitive to economic downturns.[17] Analysis on a state-level will provide a more meaningful understanding of the role that a specific Medicaid program plays in health services access and health status.

This study will examine associations between source of insurance and the receipt of preventive dental services and oral health status among children and youth nationally and in Tennessee.

**METHODS**

Data Source

I conducted a cross-sectional analysis of source of insurance, receipt of preventive dental services, self-reported oral health among children and youth, ages 1 – 17 using data from the 2011-2012 National Survey of Children's Health (NSCH).[18] The 90,555 individuals in this age range were split into two samples by location – national and Tennessee. The national sample had 88,792 individuals and the

Tennessee sample had 1,763 individuals. The data are publically available, and therefore, this study was deemed exempt from review by the University of Washington Institutional Review Board.

## Source of Insurance

Source of insurance at the time of interview is the primary independent variable and is defined as whether the child is enrolled in private, public, or no insurance. Public insurance includes respondents who were enrolled in either Medicaid or the Children's Health Insurance Program at the time of the survey. "Children who are insured but do not have public insurance are coded as having private insurance coverage."[19] [20]

## Receipt of Preventive Dental Services

Preventive dental services, the primary dependent variable, is defined as seeing "a dentist for preventive care, such as check-ups and dental cleanings" within the past 12 months. [21]

## Oral Health Status

Two variables were used to indicate oral health status –oral health status and acute oral health need. Oral health status is defined as the "parents' description of the condition of their child's teeth measured as excellent, very good, good, fair, or poor (coded as the referent category)." [22] Acute oral health needs is a binary indicator of whether a child had a toothache, decayed teeth, and/or unfilled cavities in the past 12 months.

## Covariates

Covariates are based on the variables used in past work on children's dental health by Huebner and colleagues.[23] They chose covariates based on the Anderson behavioral model of health care access and utilization which separates variables into predisposing and enabling categories.[24]

Predisposing covariates include the child's gender (female – referent), the child's age (1-2 - referent, 3-5, 6-11, 12-17), the child's race (Hispanic, white, black, other), and family structure (two parent household –referent, other). The first geographic covariate includes an indicator for residence in a Metropolitan Statistical Area (MSA) which was only available for states with a population greater than 500,000 (Yes – referent, no). The second geographic variable is a binary version of the state of residence that groups the data into two samples – Tennessee and National which includes all states other than Tennessee.

Enabling covariates include the primary language spoken at home (English – referent, other), family income as a percentage of the Federal Poverty Level (0-99 % - referent, 100–199 %, 200–399 %, ≥400 %), the respondent's relation to the child (mother – referent, father, other), and the highest level of education of the mother, father, and/or guardian (more than high school, high school, less than high school - referent). The models include an indicator for whether the child had a usual source of medical care (no – referent, yes) and an indicator for whether the child had a preventive medical visit (no-referent, yes).

An indicator was included for whether the child had a special health care need (no-referent, yes) based on the CSHCN Screener, 5-item questionnaire that "identifies children across the range and diversity of childhood chronic conditions and special needs, allowing a more comprehensive and robust assessment of children's needs and health care system performance than is attainable by focusing on a single diagnosis or type of special need. The CSHCN Screener was developed by the Child and Adolescent Health Measurement Initiative (CAHMI). "[25]

Statistical Analysis

All analyses were conducted with Stata IC Version 12. "Survey results are adjusted and weighted to reflect the demographic composition of noninstitutionalized children and youth age 0–17 in each state."[26] The distribution of the study variables was examined for all covariates by sample, source of

insurance, and receipt of preventive dental services. Logistic regression was used to estimate the association of source of insurance and receipt of preventive services for both the national and Tennessee sample. Logistic regression was also used to estimate the association of source of insurance and acute oral health need for both samples. Ordinary least squares regression was used to estimate the association of source of insurance and self-reported oral health status in both samples. Chi-squared tests were used to test the distribution of source of insurance in the two samples. Likelihood ratio tests were used to test the interaction of state location and source of insurance.

Three logistic regression models were created to compare the proportion of preventive dental services in the two samples using the binary state variable (0=national, 1 =Tennessee) (**Table 5**). The fully adjusted model controls for the covariates used in the logistic regression of preventive dental services and the OLS of mean oral health status. The partially adjusted model does not include *source of insurance*. The reduced model does not include any covariates.

**RESULTS**

**Source of Insurance**

The rates of insurance in each sample were similar, with each location having only 4% of children age 1-18 without insurance. Tennessee had a 3 percentage point higher rate of public insurance (31% v. 28%, p=0.034); conversely, Tennessee had a 3 percentage point lower rate of private insurance (64% v. 67%, p=0.034). The largest portion of children in each samples had private insurance and the fewest had no insurance, a pattern which held true when the data were stratified by gender, age, children with special health care needs, receipt of preventive medical visit, and residence in a Metropolitan Statistical Area (MSA). Children were less likely to have private insurance if they had poor oral health status, were Hispanic, were not in a two parent household, had a family income below 200% of FPL, had a child with a special health care need, had no usual source of medical care, had not received a preventive medical visit, or whose parent had less than a high school education (Table 1).

**Preventive dental services**

Overall, the vast majority of children nationally (80%) and in Tennessee (79%) received preventive dental services. These rates varied by insurance source: those with private insurance were more likely to receive a preventive dental visit (US: 84%; TN: 83%) while those with public (US: 75%; TN: 72%) or no insurance (US: 53%; TN: 59%) were less likely to receive a dental visit (Table 1).

We would expect children with excellent oral health to receive preventive dental services at a greater rate than those with poor oral health. This holds true for those with private insurance (US: 84% v. 79%; TN: 84% v. 75%) and for those with no insurance (US: 60% v. 42%; TN: 52% v. 50%) (Table 2). The opposite holds true for those with public insurance (US: 73% v. 80%; TN: 69% v. 50%). Results here are only significant for the national sample.

A logistic regression was used to explore the role of location (US v. TN) on the receipt of preventive dental services. State of residence does not correlate with the rate of preventive dental services received in the fully adjusted, partial, or reduced models (Table 5). Additionally, in the partial model, which was adjusted for all covariates except insurance – location did not correlate with receipt of preventive dental services.

In the fully adjusted logistic regressions, public and private insurance were associated with greater odds of receiving preventive dental services compared to those with no insurance, with the odds ratios for the National sample being substantially greater (Table 3). For children with public insurance, those in Tennessee were twice as likely (OR=1.98, p=0.035) and those nationally were four times as likely (OR=3.92, p<0.001) as those with no insurance to receive a preventive dental visit. For children with private insurance, those in Tennessee were over two times as likely (OR=2.13, p=0.020) and those nationally were three-in-a-half times as likely (OR=3.54, p<0.001) as those with no insurance to receive a

preventive dental visit. Within the samples, estimates for the odds ratios are greater for public insurance in the National sample but greater for private insurance in Tennessee.

To further test if insurance operated differently in each state, the interaction between location and source of insurance was tested in the logistic regression of preventive dental services. This interaction was significant at a 90% confidence level (p=0.0562) (Table 7). The standard errors of this model were greater than in the model without the interaction term; consequently, the odds ratios estimates were not significant for private insurance in the Tennessee sample (OR=1.75, 95% CI [0.97, 3.15]).

**Oral Health**

*Self-reported oral health*

In both samples, very few parents reported that their children had fair or poor oral health. Nationally, 51% of children were in excellent oral health, 26% in very good oral health, 18% in good oral health, 4% in fair health and 1% in poor health. In Tennessee, the distribution was similar with 50% of children in excellent oral health, 26% in very good oral health, 19% in good oral health, 4% in fair oral health, and 1% in poor oral health. Three OLS regression models were created to compare the mean oral health status in the two samples using the binary state variable (Table 6). State of residence does not correlate with mean oral health status in the fully adjusted, partial, and reduced models.

Those with private insurance reported better oral health in both samples; those with no insurance and those with public insurance reported similar oral health. The majority of those with private insurance reported excellent oral health (US: 58%; TN: 57%) while only about a third of those with public insurance (US: 37%; TN: 36%) and no insurance (US: 33%; TN: 41%) reported excellent oral health (Table 1).

Unadjusted and fully adjusted OLS regression models were fitted for self-reported oral health status (Table 4). In the unadjusted models, those with private insurance had a higher mean self-reported oral health status (US: 3.89 [95% CI: 3.38, 3.40; p<0.001]; TN: 3.36 [3.31, 3.42; p<0.001]) than those with no insurance (US: 2.77 [2.74, 2.80]; TN: 2.88 [2.67, 3.09]). The adjusted model reduces but does not eliminate the amount of variation between the sources of insurance in mean oral health status in both samples. The difference between mean oral health status between those with private insurance and those with no insurance changes from 1.12 (TN: 0.48) in the unadjusted model to 0.24 (TN: 0.1) in the adjusted model. In Tennessee, however, only private insurance in the unadjusted model was significantly different (p<0.001). This difference in significant results most likely is because of the small difference in point estimates and the smaller relative sample size of the Tennessee sample.

To further test if insurance affects oral health status differently in each location, the interaction between state and source of insurance was tested in the regression of oral health status (Table 9). This interaction is not significant when testing for mean oral health status (p=0.793). Estimates for mean oral health status nationally did not differ, but estimates for Tennessee were smaller than the model that considered only the Tennessee sample (Table 4).

*Acute Oral Health Need*

The prevalence of acute oral health need was 16% in the national sample and 15% of the Tennessee sample (Table 1). It was greater among those with no insurance (US: 22%; TN: 21%) or public insurance (US: 23%; TN: 22%) in contrast to those with private insurance (US: 13%; TN: 12%). Children with an acute oral health need reported receiving preventive dental services at a greater rate (US: 92%; TN: 92%) than those with no acute needs (US: 78%; TN: 77%) (Table 2). This differential held when stratified by source of insurance, though children were more likely to report receiving a preventive dental service

if they had public insurance (US: 91%; TN: 90%) or private insurance (US: 95%; TN: 96%) than no insurance (US: 67%; TN: 67%).

In the fully adjusted logistic regression, source of insurance showed a protective effect on acute oral health need for public insurance (OR=0.87; p=0.019) and private insurance (OR=0.74; p<0.001) only in the national sample (Table 10). Results for the Tennessee sample were not statistically significant.

**DISCUSSION**

The estimate of the proportion of children who receive preventive dental services (US: 80%; TN: 79%) is higher than previous estimates of 21%-78%.[1, 2, 3, 4] This estimate is consistent with the 2007 NSCH from which it was estimated that 78% of children receive preventive dental services.[4]

In contrast, the estimate of children with public insurance who receive preventive dental services (US: 75%; TN: 72%) is almost double the count of Medicaid children who receive preventive dental services (US: 38%), as reported by the Department of Health and Human Services for 2011. This difference between count and estimate may be because of response bias, where parents responded with the culturally accepted response, or because parents conflated preventive dental services with other types of dental services.

Despite variances in estimates, these findings are consistent with other research that suggests that children with insurance are more likely to receive preventive dental visits.[9, 10, 11] There was a differential effect of insurance – both public and private – on ORs for receipt of preventive dental services when comparing national and Tennessee samples. Because this difference appears for both public and private insurance, our original hypothesis that differences in Medicaid and other public insurance programs among states which affect preventive dental services does not appear supported. However, other differences among states may alter the effectiveness of insurance.

Systematic differences in the uninsured population may explain the low rates of preventive dental visits and poorer oral health. Only a small proportion of kids do not have health insurance (4%), which may be the result of potential confounders such as instability (between jobs, moving locations, etc.), self-reliance, or general distrust of the health care system.

Preventive dental care for children must be covered by Medicaid plans, but many private insurance plans do not cover dental care.[27] All other things being equal, since those with public insurance are more likely to have dental coverage, those with public insurance should have higher rates of preventive dental care. While most private insurance plans do not cover dental services, children enrolled in private insurance were 2-4 times as likely to receive preventive dental services. Consequently, the relationship between private insurance and preventive dental services may be correlative but not causative. Rather, a latent variable, such as advantageous selection, may account for the similar rate of receipt of preventive dental services. In advantageous selection, those with better health are more likely to purchase insurance, as demonstrated by Fang and colleagues among Medicare beneficiaries.[28] Another explanation may be insurance-related barriers that are more prevalent among those with public insurance, such as inability to find a dentist that accepts their coverage.[29]

*Role of acute oral health needs and oral health status*

Self-reported oral health status does differ by insurance type, but when adjusted for other covariates, the difference is slight since much of the effect of insurance is mediated through covariate factors (Table 4). The variable "Oral health status" is subjective and uses a 5-point scale that narrows the range of responses. (Individuals are not likely to answer in the negative extreme which narrows the distribution of answers.) In contrast, acute oral health need requires recall of specific conditions. As expected, in a Chi-squared test, acute oral health need and self-reported oral health status are correlated ($p<0.01$) (Table 9). Among those who reported poor oral health status, 63.50% reported

having an acute oral health need in the past 12 months. Even though these variables are correlated, regression results indicate that they are measuring different aspects of children's oral health. Those with acute dental needs may be more diligent in seeking out dental services. As such, those with oral health needs may be more likely to receive a preventive dental visit. This effect obscures our ability to determine the true effect of preventive care on acute oral health need.

*Strengths/Weaknesses*

The strengths of this study include the large national and state sample sizes. This study has several limitations *(Adapted from Bell 2012).* First, the data are cross-sectional and cannot show the direction of the associations between source of insurance, receipt of preventive dental services, and oral health status. Second, since the study is observational, we could only control for variables that were gathered. Other variables may influence results. Third, responses to questions were not validated leaving answers open to recall bias or response bias. The survey asks respondents to answer about behavior and events over the past 12 months without using any memory aids; as such, parents may not correctly remember exactly when the dental visits occurred. (Survey instruments that ask participants to recall the specific month of last visit may alleviate this bias.) In addition, the survey is subject to response bias since questions ask about activities that may be viewed as socially desirable. Parents may answer the questions positively rather than reveal they have not taken their child to a preventive dental visit or that their children have poor oral health. Fourth, the survey question about preventive dental service referenced services like check-ups and dental cleanings, so the variable may not fully capture other types of preventive services like fluoride treatment. Fifth, these models only use a cross-sectional insurance variable and as such do not account for consistency or adequacy of insurance. Of those with insurance, 22% rated their current insurance as inadequate and 9% were not consistently insured over the previous 12 months. Accounting for the quality of insurance could further differentiate the role of

insurance in each state. Additionally, respondents may conflate preventive dental services and treatment or diagnostic services which would inflate the rate of preventive visits. Finally, cultural differences in how parents respond to questions may influence some results.

**CONCLUSIONS**

While insurance is correlated with receipt of preventive *dental* care, a causative relationship is questionable. Those with insurance have a greater likelihood of receiving preventive dental services, but the exact mechanism of this relationship is unknown. More research is needed to explore potential latent variables, particularly among parents' role in choosing or denying insurance. Additionally, the role of insurance on receipt of preventive dental services seems to be less influential in Tennessee than nationally, and more research is needed to see what accounts for this difference. The correlation between source of insurance and oral health status is largely mediated through covariates. However, changes in the insurance market as a result of the Affordable Care Act, particularly the individual mandate and the requirement to cover children's dental in the Health Insurance Exchanges, may alter these relationships. Future research should rely more heavily on validated variables and time order. More state-specific research is needed to understand the role of insurance and consumer behavior. The differences in public insurance programs and state insurance markets provides a ripe environment for natural experiments. Regardless of the mechanisms at play, health insurance is correlated with positive results for children, and public health efforts to maintain and expand health and dental insurance should continue.

**Table 1.** Characteristics of children and youth by locality and insurance status

| | Sample % | National Insurance | | | p | Sample % | Tennessee Insurance | | | p |
|---|---|---|---|---|---|---|---|---|---|---|
| | n = | None | Public | Private | | n = | None | Public | Private | |
| | 87,720 (100%) | 3,846 (4%) | 24,968 (28%) | 58,906 (67%) | | 1,752 | 76 (4%) | 548 (31%) | 1,128 (64%) | * |
| Receipt of preventive dental Services | 70,915 (80%) | 2,040 (53%) | 49,473 (75%) | 49,473 (84%) | p<0.001 | 1,384 (79%) | 45 (59%) | 392 (72%) | 940 (83%) | p<0.001 |
| Self-reported oral health status | | | | | p<0.001 | | | | | p<0.001 |
| Excellent | 45,304 (51%) | 1,285 (33%) | 9,335 (37%) | 34.304 (58%) | | 877 (50%) | 31 (41%) | 197 (36%) | 646 (57%) | |
| Very Good | 23,083 (26%) | 1,000 (26%) | 6,614 (27%) | 15,170 (26%) | | 466 (26%) | 17 (23%) | 154 (28%) | 290 (26%) | |
| Good | 15,569 (18%) | 1,036 (27%) | 6,506 (26%) | 7,740 (13%) | | 326 (19%) | 16 (21%) | 150 (28%) | 157 (14%) | |
| Fair | 3,852 (4%) | 413 (11%) | 1,976 (8%) | 1,381 (2%) | | 74 (4%) | 9 (12%) | 38 (7%) | 27 (2%) | |
| Poor | 914 (1%) | 105 (3%) | 508 (2%) | 282 (0.48%) | | 18 (1%) | 2 (3%) | 8 (1%) | 8 (7%) | |
| Acute oral health need** | | | | | p<0.001 | | | | | p<0.001 |
| | 9,468 (16%) | 835 (22%) | 5,746 (23%) | 7,693 (13%) | | 268 (15%) | 16 (21%) | 118 (22%) | 113 (12%) | |
| Gender | | | | | p=0.300 | | | | | p=0.230 |
| Female | 43,012 (49%) | 2,006 (52%) | 12,036 (48%) | 28,644 (49%) | | 841 (48%) | 43 (57%) | 253 (46%) | 539 (48%) | |
| Age, years | | | | | p<0.001 | | | | | p<0.001 |
| 1 – 2 | 8,786 (10%) | 319 (8%) | 3,148 (13%) | 5,211 (19%) | | 179 (10%) | 9 (11%) | 82 (15%) | 87 (8%) | |
| 3 – 5 | 15,584 (18%) | 575 (15%) | 5,418 (22%) | 9,369 (16%) | | 326 (18%) | 14 (18%) | 116 (21%) | 194 (17%) | |
| 6 – 11 | 30,507 (34%) | 1,322 (34%) | 8,575 (34%) | 20,215 (34%) | | 572 (29%) | 22 (4%) | 177 (33%) | 370 (33%) | |
| 12 – 17 | 33,915 (38%) | 1,630 (42%) | 7,827 (31%) | 24,111 (41%) | | 686 (39%) | 31 (41) | 173 (32%) | 477 (42%) | |
| Race / ethnicity | | | | | p<0.001 | | | | | p<0.001 |
| White non-hispanic | 56,978 (64%) | 1,883 (49%) | 11,293 (45%) | 43,353 (74%) | | 1,266 (72%) | 47 (62%) | 338 (62%) | 874 (77%) | |
| Black non-hispanic | 8,251 (9%) | 352 (9%) | 4,255 (17%) | 3,504 (6%) | | 195 (11%) | 6 (8%) | 90 (16%) | 98 (9%) | |
| Hispanic | 11,786 (13%) | 1,064 (28%) | 5,625 (23%) | 4,873 (8%) | | 115 (7%) | 11 (14%) | 64 (12%) | 39 (3%) | |
| Other non-hispanic | 9,666 (11%) | 435 (11%) | 3,082 (12%) | 5,962 (10%) | | 144 (8%) | 12 (16%) | 43 (8%) | 88 (8%) | |
| Family Structure | | | | | p<0.001 | | | | | p<0.001 |
| Two parents, married or cohabitating | 67,350 (77%) | 2,718 (72%) | 13,187 (54%) | 50,798 (87%) | | 1,263 (73%) | 49 (64%) | 250 (46%) | 960 (86%) | |
| Single parent or other | 20,374 (23%) | 1,057 (28%) | 1,394 (46%) | 7,533 (13%) | | 475 (27%) | 27 (36%) | 289 (54%) | 153 (14%) | |
| Family income | | | | | p<0.001 | | | | | p<0.001 |
| 0 – 99% FPL*** | 13,571 (15%) | 1,027 (27%) | 10,566 (42%) | 1,671 (3%) | | 330 (19%) | 23 (30%) | 260 (47%) | 41 (4%) | |
| 100 – 199% FPL*** | 15,898 (18%) | 1,301 (34%) | 8,379 (34%) | 5,943 (10%) | | 349 (20%) | 26 (34%) | 172 (31%) | 150 (13%) | |
| 200 – 399% FPL*** | 26,996 (30%) | 1,098 (29%) | 4,347 (17%) | 21,238 (36%) | | 549 (31%) | 19 (25%) | 91 (17%) | 435 (39%) | |
| 400% FPL** or greater | 32,327 (36%) | 420 (11%) | 1,676 (7%) | 30,054 (51%) | | 535 (30%) | 9 (11%) | 25 (5%) | 502 (45%) | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Child has special health care needs | | | | | p<0.001 | | | | | p=0.001 |
| Yes | 19,021 (21%) | 497 (13%) | 7,012 (28%) | 11,364 (19%) | | 437 (25%) | 10 (13%) | 163 (30%) | 261 (23%) | |
| No | 69,771 (79%) | 3,349 (87%) | 17,956 (72%) | 47,542 (81%) | | 1,326 (75%) | 66 (87%) | 385 (70%) | 867 (77%) | |
| Child has usual source of medical care | | | | | p<0.001 | | | | | p<0.001 |
| Yes | 84,611 (95% | 3,069 (80%) | 23,324 (93%) | 57,285 (97%) | | 1,694 (96%) | 71 (93%) | 512 (93%) | 1,100 (98%) | |
| No | 4,020 (4%) | 767 (20%) | 1,586 (6%) | 1,558 (3%) | | 68 (4%) | 5 (7%) | 35 (6%) | 28 (2%) | |
| Received preventive medical visit | | | | | p<0.001 | | | | | p<0.001 |
| Yes | 74,393 (84%) | 2,176 (57%) | 20,775 (83%) | 50,702 (86%) | | 1,511 (86%) | 46 (61%) | 467 (85%) | 989 (88%) | |
| No | 13,742 (15%) | 1,632 (42%) | 3,910 (16%) | 7,941 (13%) | | 234 (13%) | 26 (34%) | 69 (13%) | 138 (12%) | |
| Primary Language Spoken | | | | | p<0.001 | | | | | p<0.001 |
| English | 81,903 (92%) | 2,950 (77%) | 21,257 (85%) | 56,853 (97%) | | 1,687 (96%) | 65 (86%) | 500 (91%) | 1,112 (99%) | |
| Other | 6,830 (8%) | 894 (23%) | 3,692 (5%) | 2,017 (3%) | | 76 (4%) | 11 (14%) | 48 (9%) | 16 (1%) | |
| Respondent relationship | | | | | p<0.001 | | | | | p<0.001 |
| Mother | 60,786 (69%) | 2,593 (68%) | 16,932 (68%) | 40,805 (70%) | | 1,156 (66%) | 54 (71%) | 340 (63%) | 759 (68%) | |
| Father | 21,284 (24%) | 849 (22%) | 3,991 (16%) | 16,140 (28%) | | 408 (23%) | 13 (17%) | 68 (13%) | 326 (29%) | |
| Other | 6,329 (7%) | 376 (10%) | 3,905 (16%) | 1,746 (3%) | | 187 (11%) | 9 (12%) | 136 (25%) | 35 (3%) | |
| Highest education level of parents | | | | | p<0.001 | | | | | p<0.001 |
| Less than high school | 5,213 (6%) | 610 (16%) | 3,741 (15%) | 733 (1%) | | 115 (7%) | 12 (16%) | 84 (16%) | 17 (2%) | |
| High school only | 13,407 (15%) | 966 (26%) | 7,349 (30%) | 4,805 (8%) | | 340 (20%) | 23 (30%) | 197 (37%) | 116 (10%) | |
| More than high school | 68,522 (79%) | 2,162 (58%) | 13, 259 (54%) | 52,509 (90%) | | 1,272 (74%) | 41 (54%) | 252 (47%) | 975 (88%) | |
| Residence in MSA**** | | | | | p<0.001 | | | | | p<0.001 |
| Yes | 46,665 (78%) | 1,947 (75%) | 12,379 (71%) | 31,774 (82%) | | 1,279 (74%) | 55 (72%) | 348 (65%) | 871 (79%) | |
| No | 12,832 (22%) | 659 (25%) | 4,986 (29%) | 7,004 (18%) | | 451 (26%) | 21 (28%) | 188 (35%) | 238 (21%) | |

*Pearson chi2(2)=6.7446 p=0.034

** Acute oral health needs is a binary indicator of whether a child had a toothache, decayed teeth, and/or unfilled cavities in the past 12 months.

*** FPL – Federal Poverty Level.

****MSA – Metropolitan Statistical Area; Data available for only 35 states with populations over 500,000

**Table 2.** Receipt of preventive dental services by insurance source and selected covariates

| | | National Insurance | | | | | Tennessee Insurance | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sample % | | | | p | Sample % | | | | p |
| Receipt of preventive services | n = | None | Public | Private | | n = | None | Public | Private | |
| All | 70,915 (80%) | 2,040 (53%) | 49,473 (75%) | 49,473 (84%) | | 1,384 (79%) | 45 (59%) | 392 (72%) | 940 (83%) | |
| Self-reported oral health status | | | | | | | | | | |
| Excellent | 36,360 (81%) | 771 (60%) | 6,823 (73%) | 28,766 (84%) | p<0.01 | 692 (80%) | 16 (52%) | 133 (69%) | 543 (84%) | p<0.01 |
| Very Good | 18,435 (81%) | 558 (56%) | 4,988 (76%) | 12,889 (85%) | p<0.01 | 360 (78%) | 12 (71%) | 112 (73%) | 236 (81%) | P=0.10 |
| Good | 11,848 (78%) | 499 (48%) | 4,921 (76%) | 6,428 (83%) | p<0.01 | 255 (79%) | 11 (69%) | 114 (77%) | 130 (83%) | p=0.23 |
| Fair | 2,840 (76%) | 167 (41%) | 1,517 (77%) | 1,156 (84%) | p<0.01 | 59 (81%) | 5 (63%) | 29 (76%) | 25 (93%) | p=0.98 |
| Poor | 670 (75%) | 44 (42%) | 403 (80%) | 223 (79%) | p<0.01 | 11 (61%) | 1 (50%) | 4 (50%) | 6 (75%) | p=0.56 |
| Acute oral health need* | | | | | | | | | | |
| None | 56,994 (78%) | 1,480 (50%) | 13,384 (70%) | 42,130 (83%) | p<0.01 | 1,130 (77%) | 35 (60%) | 284 (67%) | 811 (82%) | p<0.01 |
| YES (1+) | 13,059 (92%) | 556 (67%) | 5,225 (91%) | 7,278 (95%) | p<0.01 | 244 (92%) | 10 (67%) | 106 (90%) | 128 (96%) | p<0.01 |
| Gender | | | | | | | | | | |
| Female | 34,244 (81%) | 994 (54%) | 9,100 (76%) | 24,150 (84%) | p<0.01 | 721 (79%) | 24 (75%) | 210 (72%) | 487 (83%) | p<0.01 |
| Male | 35,849 (80%) | 1,044 (52%) | 9,554 (74%) | 25,251 (84%) | p<0.01 | 652 (78%) | 21 (49%) | 182 (73%) | 449 (83%) | p<0.01 |
| Age, years | | | | | | | | | | |
| 1 – 2 | 2,029 (23%) | 62 (19%) | 947 (30%) | 1,020 (20%) | p<0.01 | 45 (26%) | 2 (22%) | 24 (29%) | 19 (22%) | p=0.53 |
| 3 - 5 | 11,329 (74%) | 273 (48%) | 3,941 (73%) | 7,115 (76%) | p<0.01 | 221 (69%) | 4 (29%) | 77 (68%) | 140 (72%) | p<0.01 |
| 6 – 11 | 27,184 (91%) | 834 (64%) | 7,370 (86%) | 18,980 (94%) | p<0.01 | 502 (89%) | 16 (76%) | 150 (86%) | 336 (91%) | p=0.05 |
| 12 – 17 | 29,633 (89%) | 871 (54%) | 6,404 (82%) | 22,358 (93%) | p<0.01 | 609 (90%) | 23 (74%) | 141 (82%) | 445 (93%) | p<0.01 |
| Race / ethnicity | | | | | | | | | | |
| White non-hispanic | 46,302 (82%) | 1,056 (56%) | 8,428 (75%) | 36,818 (85%) | p<0.01 | 998 (80%) | 27 (59%) | 239 (72%) | 732 (84%) | p<0.01 |
| Black non-hispanic | 6,317 (78%) | 168 (48%) | 3,214 (76%) | 2,935 (84%) | p<0.01 | 159 (82%) | 3 (50%) | 70 (79%) | 86 (88%) | p=0.03 |
| Hispanic | 8,723 (76%) | 525 (50%) | 4,285 (77%) | 3,913 (80%) | p<0.01 | 85 (75%) | 7 (64%) | 47 (73%) | 31 (79%) | p=0.54 |
| Other non-hispanic | 7,237 (77%) | 228 (53%) | 2,215 (72%) | 4,794 (81%) | p<0.01 | 99 (69%) | 8 (67%) | 25 (58%) | 66 (75%) | p=0.14 |
| Family Structure | | | | | | | | | | |
| Two parents, married or cohabitating | 54,115 (81%) | 1,481 (55%) | 9,995 (76%) | 42,639 (84%) | p<0.01 | 998 (80%) | 28 (58%) | 172 (70%) | 798 (83%) | p<0.01 |
| Single parent or other | 15,276 (77%) | 524 (50%) | 8,387 (74%) | 6,365 (85%) | p<0.01 | 359 (77%) | 17 (63%) | 213 (74%) | 129 (84%) | p=0.01 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Family income | | | | | | | | | | |
| 0 – 99% FPL** | 9,168 | 442 | 7,488 | 1,238 | p<0.01 | 224 | 9 | 182 | 33 | p<0.01 |
| | (70%) | (43%) | (71%) | (75%) | | (70%) | (41%) | (71%) | (80%) | |
| 100 – 199% FPL** | 11,643 | 661 | 6,481 | 4,501 | p<0.01 | 253 | 15 | 126 | 112 | p=0.17 |
| | (75%) | (51%) | (78%) | (76%) | | (73%) | (58%) | (76%) | (75%) | |
| 200 – 399% FPL** | 21,539 | 647 | 3,384 | 17,508 | p<0.01 | 437 | 16 | 64 | 357 | p=0.05 |
| | (81%) | (59%) | (78%) | (83%) | | (80%) | (84%) | (71%) | (82%) | |
| 400% FPL** or greater | 27,825 | 290 | 1,309 | 26,226 | p<0.01 | 463 | 5 | 20 | 438 | p=0.08 |
| | (87%) | (69%) | (79%) | (87%) | | (87%) | (63%) | (80%) | (87%) | |
| Child has special health care needs | | | | | | | | | | |
| Yes | 54,003 | 1,753 | 12,964 | 39,286 | p<0.01 | 1,017 | 40 | 271 | 706 | p<0.01 |
| | (79%) | (53%) | (73%) | (83%) | | (77%) | (61%) | (71%) | (81%) | |
| No | 16,172 | 287 | 5,698 | 10,187 | p<0.01 | 360 | 5 | 121 | 234 | p<0.01 |
| | (86%) | (58%) | (82%) | (90%) | | (84%) | (56%) | (75%) | (90%) | |
| Child has usual source of medical care | | | | | | | | | | |
| Yes | 2,579 | 319 | 1,083 | 1,177 | p<0.01 | 47 | 4 | 21 | 22 | p=0.25 |
| | (66%) | (42%) | (69%) | (76%) | | (69%) | (80%) | (60%) | (79%) | |
| No | 67,512 | 1,717 | 17,543 | 48,252 | p<0.01 | 1,329 | 41 | 370 | 918 | p<0.01 |
| | (81%) | (56%) | (76%) | (84%) | | (79%) | (59%) | (73%) | (83%) | |
| Received preventive medical visit | | | | | | | | | | |
| Yes | 9,703 | 687 | 2,538 | 6,478 | p<0.01 | 171 | 15 | 45 | 111 | p=0.01 |
| | (72%) | (42%) | (65%) | (82%) | | (73%) | (58%) | (65%) | (80%) | |
| No | 60,118 | 1,338 | 15,968 | 42,812 | p<0.01 | 1,199 | 30 | 340 | 829 | p<0.01 |
| | (82%) | (62%) | (77%) | (85%) | | (80%) | (65%) | (73%) | (84%) | |
| Primary Language Spoken | | | | | | | | | | |
| English | 65,476 | 1,612 | 15,809 | 48,055 | p<0.01 | 1,328 | 39 | 361 | 928 | p<0.01 |
| | (81%) | (55%) | (75%) | (85%) | | (80%) | (61%) | (73%) | (83%) | |
| Other | 4,658 | 427 | 2,841 | 1,390 | p<0.01 | 49 | 6 | 31 | 12 | p=0.54 |
| | (71%) | (48%) | (77%) | (69%) | | (65%) | (55%) | (65%) | (75%) | |
| Respondent relationship | | | | | | | | | | |
| Mother | 48,604 | 1,399 | 12,807 | 34,398 | p<0.01 | 911 | 31 | 241 | 639 | p<0.01 |
| | (81%) | (54%) | (76%) | (84%) | | (79%) | (58%) | (72%) | (84%) | |
| Father | 16,872 | 449 | 2,920 | 13,503 | p<0.01 | 322 | 7 | 47 | 268 | p<0.01 |
| | (81%) | (54%) | (74%) | (84%) | | (79%) | (54%) | (69%) | (82%) | |
| Other | 4,402 | 175 | 2,832 | 1,395 | p<0.01 | 134 | 7 | 101 | 26 | p=0.97 |
| | (74%) | (47%) | (73%) | (81%) | | (76%) | (78%) | (76%) | (74%) | |
| Highest education level of parents | | | | | | | | | | |
| Less than high school | 3,555 | 269 | 2,735 | 551 | p<0.01 | 78 | 9 | 58 | 11 | p=0.84 |
| | (70%) | (45%) | (74%) | (76%) | | 69.64 | 75.00 | 69.88 | 64.71 | |
| High school only | 9,586 | 458 | 5,317 | 3,811 | p<0.01 | 258 | 13 | 149 | 96 | p=0.04 |
| | (73%) | (48%) | (73%) | (80%) | | (77%) | (59%) | (76%) | (83%) | |
| More than high school | 55,816 | 1,257 | 10,165 | 44,394 | p<0.01 | 1,013 | 23 | 173 | 817 | p<0.01 |
| | (82%) | (58%) | (77%) | (85%) | | (80%) | (56%) | (70%) | (84%) | |
| Residence in MSA*** | | | | | | | | | | |
| Yes | 37,055 | 1,040 | 9,256 | 26,759 | p<0.01 | 1,004 | 33 | 239 | 732 | p<0.01 |
| | (81%) | (54%) | (75%) | (84%) | | (79%) | (60%) | (69%) | (84%) | |
| No | 9,756 | 321 | 3,670 | 5,765 | p<0.01 | 348 | 12 | 143 | 193 | p=0.08 |
| | (77%) | (49%) | (74%) | (82%) | | (79%) | (60%) | (78%) | (81%) | |

* Acute oral health needs is a binary indicator of whether a child had a toothache, decayed teeth, and/or unfilled cavities in the past 12 months.

** FPL – Federal Poverty Level.

***MSA – Metropolitan Statistical Area; Data available for only 35 states with populations over 500,000

**Table 3.** Logistic regression of receipt of preventive dental services in past year

| | Insurance status OR [95% CI] | | | |
|---|---|---|---|---|
| | Nationally | *p* | Tennessee | *p* |
| No insurance | -- | -- | -- | -- |
| Public insurance | 3.93 [3.53, 4.36] | p<0.001 | 1.98 [1.05, 3.72] | p=0.035 |
| Private insurance | 3.54 [3.18, 3.93] | p<0.001 | 2.13 [1.13, 4.00] | p=0.020 |

Estimates from a logistic regression model controlled for gender, age, race/ethnicity, family structure, family income, child having a special health care need, child having a usual source of medical care, receipt of preventive medical visit, primary language spoken, respondent relationship, highest education level of parents, and residence in a Metropolitan Statistical Area (MSA). (Huebner 2012.)

**Table 4.** Mean self-reported oral health status by insurance type.

| | Nationally | | | | Tennessee | | | |
|---|---|---|---|---|---|---|---|---|
| | Unadjusted model | p-value | Fully adjusted | p-value | Unadjusted model | p-value | Fully adjusted | p-value |
| No insurance | 2.77 [2.74, 2.80] | -- | 2.88 [2.82, 2.94] | -- | 2.88 [2.67, 3.09] | -- | 3.03 [2.66, 3.39] | -- |
| Public Insurance | 2.89 [2.88, 2.91] | p<0.001 | 2.99 [2.94, 3.04] | p<0.001 | 2.90 [2.83, 2.98] | p=0.839 | 3.13 [2.81, 3.45] | p=0.345 |
| Private Insurance | 3.89 [3.38, 3.40] | p<0.001 | 3.12 [3.07, 3.18] | p<0.001 | 3.36 [3.31, 3.42] | p<0.001 | 3.13 [2.80, 3.46] | p=0.342 |

**Controlled for relevant covariates.*
*0 – Poor*
*1 – Fair*
*2 – Good*
*3 – Very Good*
*4 – Excellent*

**Table 5.** Logistic regressions of preventive dental services with Location (TN v. US) as main predictor.

| | Full | | Partial* | | Reduced | |
|---|---|---|---|---|---|---|
| | OR [95% CI] | p-value | OR [95% CI] | p-value | OR [95% CI] | p-value |
| US | -- | -- | -- | -- | -- | -- |
| TN | 0.97 [0.85, 1.12] | p=0.688 | 0.97 [0.85, 1.11] | p=0.661 | 0.93 [0.83, 1.04] | p=0.199 |

*Without insurance covariate

**Table 6.** OLS regressions of oral health status with Location (TN v. US) as main predictor.

| | Full | | Partial* | | Reduced | |
|---|---|---|---|---|---|---|
| | Mean oral health [95% CI] | p-value | Mean oral health [95% CI] | p-value | Mean oral health [95% CI] | p-value |
| US | 2.89 [2.84, 2.95] | -- | 2.95 [2.90, 3.00] | -- | 3.22 [3.21, 3.22] | -- |
| TN | 2.89 [2.82, 2.96] | p=0.995 | 2.96 [2.89, 3.02] | p=0.843 | 3.20 [3.15, 3.24] | p=0.401 |

*Without insurance covariate

**Table 7.** OR of receipt of preventive dental services, using Location (TN v. US) as an interaction term*

| | Nationally | | Tennessee | |
|---|---|---|---|---|
| | OR [95% CI] | p-value | OR [95% CI] | p-value |
| No Insurance | -- | -- | -- | -- |
| Public Insurance | 3.92 [3.53, 4.36] | p<0.001 | 1.98 [1.08, 3.63] | p=0.028 |
| Private Insurance | 3.55 [3.20, 3.94] | p<0.001 | 1.75 [0.97, 3.15] | p=0.064 |

*Likelihood ratio test of Bistate as an interaction term: LR chi2(2)=5.76 p=0.056

**Table 8.** Mean oral health status, using Location (TN v. US) as an interaction term*

| | Nationally | | Tennessee | |
|---|---|---|---|---|
| | Mean [95% CI] | p-value | Mean [95% CI] | p-value |
| No Insurance | 2.88 [2.82, 2.94] | p<0.001 | 2.88 [2.82, 2.94] | p<0.001 |
| Public Insurance | 2.99 [2.94, 3.04] | p<0.001 | 2.94 [2.73, 3.16] | p<0.001 |
| Private Insurance | 3.12 [3.07, 3.18] | p<0.001 | 3.06 [2.85, 3.27] | p<0.001 |

*Likelihood ratio test of Bistate as an interaction term: LR chi2(2)=0.47 p=0.792

**Table 9.** Relationship between self-reported oral health status and acute oral health need

| Self-reported oral health status | Acute oral health need |
|---|---|
| Poor | 63.50% |
| Fair | 50.87% |
| Good | 30.17% |
| Very Good | 18.41% |
| Excellent | 6.65% |

Pearson chi-square p<0.01

**Table 10.** Logistic regression of acute oral health need in past year

| | Insurance status OR [95% CI] | | | |
|---|---|---|---|---|
| | Nationally | *p* | Tennessee | *p* |
| No insurance | -- | -- | -- | -- |
| Public insurance | 0.87 [0.77, 0.98] | p=0.019 | 1.08 [0.53, 2.22] | p=0.836 |
| Private insurance | 0.74 [0.66, 0.84] | p<0.001 | 0.70 [0.34, 1.44] | p=0.0.335 |

Estimates from a logistic regression model controlled for gender, age, race/ethnicity, family structure, family income, child having a special health care need, child having a usual source of medical care, receipt of preventive medical visit, primary language spoken, respondent relationship, highest education level of parents, and residence in a Metropolitan Statistical Area (MSA). (Huebner 2012.)

# Data Analysis Citations

[1] Huebner CE, Bell JF, Reed SC. Receipt of Preventive Oral Health Care by U.S. Children: A Population-Based Study of the 2005-2008 Medical Expenditure Panel Surveys. Matern Child Health J. 2012 Oct 20.
[2] Child and Adolescent Health Measurement Initiative (2012). "Fast Facts: 2011/12 National Survey of Children's Health." Data Resource Center, supported by Cooperative Agreement 1-U59-MC06980-01 from the U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB). Available at www.childhealthdata.org. Revised 1/10/13.
[3] Kenney GM, McFeeters JR, Yee JY. Preventive Dental Care and Unmet Dental Needs Among Low-Income Children. American Journal of Public Health. 2005:95(8):1360-1366.
[4] Bell JF, Huebner CE, Reed, SC. Oral Health Need and Access to Dental Services: Evidence from the National Survey of Children's Health, 2007. Matern Child Health J (2012) 16:S27-S34.
[5] Romaire, MA. Bell, JF. Huebner CE. Variations in Children's Dental Service Use Based on Four National Health Surveys. Pediatrics 2012;130;e1182; originally published online October 15, 2012.
[6] US Department of Health and Human Services, Centers for Medicare and Medicaid Services, "Medicaid Early Periodic Screening Diagnostic & Treatment Benefit (CMS-416)," (2009)
[7] Pew. A Costly Dental Destination Hospital Care Means States Pay Dearly. 2012.
[8] Ibid 4.
[9] Bell JF, Huebner CE, Reed, SC. Oral Health Need and Access to Dental Services: Evidence from the National Survey of Children's Health, 2007. Matern Child Health J (2012) 16:S27-S34.
[10] Huebner CE, Bell JF, Reed SC. Receipt of Preventive Oral Health Care by U.S. Children: A Population-Based Study of the 2005-2008 Medical Expenditure Panel Surveys. Matern Child Health J. 2012 Oct 20.
[11] Romaire, MA. Bell, JF. Huebner CE. Variations in Children's Dental Service Use Based on Four National Health Surveys. Pediatrics 2012;130;e1182; originally published online October 15, 2012.
[12] Perry CD, Kenney GM. Preventive Care for Children in Low-Income Families: How Well Do Medicaid and State Children's Health Insurance Programs Do? Pediatrics. 2007:120(1393).
[13] Fischer MA, Mascarenhas AK. A Comparison of Medical and Dental Outcomes for Medicaid-Insured and MUninsured Medicaid-eligible Children: A U.S. Population-Based Study. JADA 2009:140(11):1403-1412.
[14] Fischer MA, Mascarenhas AK. A Comparison of Medical and Dental Outcomes for Medicaid-Insured and MUninsured Medicaid-eligible Children: A U.S. Population-Based Study. JADA 2009:140(11):1403-1412.
[15] Kenney GM, Marton J, Klein AE, Pelletier JE, Talbert J. The Effects of Medicaid and CHIP Policy Changes on Receipt of Preventive Care among Children. Health Services Research. 2010:298-318.
[16] State Health Facts. Income Eligibility Limits for Children's Regular Medicaid and Children's CHIP-funded Medicaid Expansions as a Percent of Federal Poverty Level (FPL), January 2013. Accessed March 2013. http://www.statehealthfacts.org/comparereport.jsp?rep=76&cat=4.
[17] Blewett. Harvesting the Lessons of State Health Policy. 2011. Health Services Research.
[18] US Department of Health and Human Services. (2012). HRSA, maternal and child health bureau. The national survey of children's health.
[19] 2011/12 National Survey of Children's Health. Child and Adolescent Health Measurement Initiative (CAHMI), "2011-2012 NSCH: Child Health Indicator and Subgroups SAS Codebook, Version 1.0" 2013, Data Resource Center for Child and Adolescent Health, sponsored by the Maternal and Child Health Bureau. www.childhealthdata.org.
[20] Question K3Q01 defines health insurance as including "health insurance, prepaid plans such as HMOs, or government plans such as Medicaid." In K3Q02 public insurance is defined as "Medicaid or the State Children's Health Insurance Program, S-CHIP" and names the Medicaid and/or SCHIP programs for the state the child resides in. Children who are insured but do not have public insurance are coded as having private insurance coverage.
[21] Ibid 18: SAS Codebook
[22] Ibid 8: Bell 2012
[23] (Bell, Huebner, and Reed 2007).
[24] Bell, Huebner, and Reed 2007, Lewis 2010
[25] Ibid 18: SAS Codebook
[26] Ibid 18: SAS Codebook p. 2

[27] Manski, RJ. Cooper, PF. Characteristics of Employers Offering Dental Coverage in the United States. Journal of the American Dental Association. June 2010 vol. 141 no. 6 700-711. Available at http://jada.info/content/141/6/700.short

[28] Fang, H. Keane, M. Silverman, D. Sources of Advantageous Selection: Evidence from the Medigap Insurance Market. Journal of Political Economy, 2008, vol. 116, no. 2.

[29] Schrimshaw, EW. Siegel, K. Wolfson, NH. Mitchell, DA. Kunzel, C. Insurance-Related Barriers to Accessing Dental Care Among African American Adults With Oral Health Symptoms in Harlem, New York City. Am J Public Health. 2011 August; 101(8): 1420–1428.

**Appendix A: Scientific and Statistical Objectives**

The main scientific objective is to determine if **source of insurance** is *associated* with **preventive dental visits** or with **oral health**. I hypothesize that the listed variables will act as confounders based on their use in previous research (Huebner 2012, Bell 2007, Lewis 2007).

*Tennessee:*

1. Is ***source of insurance*** associated with the ***receipt of preventive dental services*** among children and youth in Tennessee when controlling for the stated variables?
    a. Logistic regression:
    logit (pi(X)) = $\beta_0 + \beta_1$ * insurance + $\beta_2$ * confounder1 + …. + $B_{1+k}$ *confounder k
    $H_o$: $\beta_1 = 0$; $H_a$: $\beta_1 \neq 0$

2. Is ***source of insurance*** associated with ***oral health status*** among children and youth in Tennessee when controlling for the stated variables?
    **a.** OLS regression:
    Mean oral health = $\beta_0 + \beta_1$ * insurance + $\beta_2$ * confounder1 + …. + $B_{1+k}$ *confounder k
    $H_o$: $\beta_1 = 0$; $H_a$: $\beta_1 \neq 0$

*Nationally:*

3. Is ***source of insurance*** associated with the ***receipt of preventive dental services*** among children and youth nationally when controlling for the stated variables?
    a. Logistic regression:
    logit (pi(X)) = $\beta_0 + \beta_1$ * insurance + $\beta_2$ * confounder1 + …. + $B_{1+k}$ *confounder k
    $H_o$: $\beta 1 = 0$; $H_a$: $\beta 1 \neq 0$

4. Is ***source of insurance*** associated with ***oral health status*** among children and youth nationally when controlling for the stated variables?
    a. OLS regression:
    Mean oral health= $\beta_0 + \beta_1$ * insurance + $\beta_2$ * confounder1 + …. + $B_{1+k}$ *confounder k
    $H_o$: $\beta 1 = 0$; $H_a$: $\beta 1 \neq 0$

*Comparison:*

5. Does the **source of insurance** differ between children and youth in Tennessee compared with those nationally when controlling for the stated variables?
    a. Chi-square test to compare *unordered categorical* variables between *two groups*.

6. Does ***receipt of preventive dental services*** differ between children and youth in Tennessee compared with those nationally when controlling for the stated variables?
    a. Logistic regression, fully adjusted

b. Logistic regression, partially adjusted
c. Logistic regression, reduced

**7.** Does ***oral health status*** differ between children and youth in Tennessee compared with those nationally when controlling for the stated variables?
   a. OLS regression, fully adjusted
   b. OLS regression, partially adjusted
   c. OLS regression, reduced

**8.** Does the association of ***source of insurance*** with the ***receipt of preventive dental services*** differ between children and youth in Tennessee compared with those nationally when controlling for the stated variables?
   a. Compare *logistic regressions* between two groups using an interaction term between ***source of insurance*** and ***state***
   b. Use Likelihood ratio test

**9.** Does the association between ***source of insurance*** and ***oral health status*** differ between children and youth in Tennessee compared with those nationally when controlling for the stated variables?
   a. Compare *OLS regressions* between two groups using an interaction term between ***source of insurance*** and ***state***
   b. Use Likelihood ratio test