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Are There Rural-Urban Differences in Dentist Supply?

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Are There Rural-Urban Differences in Dentist Supply?

CAPSTONE PROJECT PAPER

A paper submitted in partial fulfillment of the

Requirements for the degree of

Master of Public Health in the

University of Kentucky College of Public Health

By

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Final Examination:

Lexington, KY

July 21, 2016

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Acknowledgments

My deepest gratitude to Dr. Wackerbarth, Dr. Harp, and Dr. Ingram for their constant assistance and guidance.

My sincere appreciation to Ms. Joanna Aalboe for her advice and support during the first two weeks of my project.

I would like to extend my gratitude to my parents and my wife for their prayers and support.

Executive Summary

The purpose of this project was to examine the supply of dentists in the Commonwealth of Kentucky at the county level. Counties with shortages in dentist supply were determined and associated factors were examined.

Several county-level variables were analyzed. These included total number of dentists, total county population, dentist to population ratio, dentist supply shortage, median household income, median age, percent of Medicaid enrollees, rurality, oral cancer crude incidence and mortality rates per 100,000 and percent of adults missing six or more teeth.

This project showed that 42 of the 120 counties in Kentucky had shortages in dentist supply. Also, results found that counties with higher median age and that were urban were more likely to have shortage in dentist supply. In addition, this study showed a significant association between percent of adults missing six or more teeth with rural counties, counties with higher median age and lower median income.

Keywords: Kentucky, dentist, supply, shortage, urban, rural, counties.

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Introduction

        Oral health is an important component of general health. Imperfect oral health is linked to an array of oral diseases and disorders including dental caries, pain, and periodontal diseases (USDHHS, 2000). Also, poor oral health increases the risk for diabetes, heart disease, and bad birth outcomes (USDHHS, 2000). Regular dental care services can help to prevent the occurrence and progress of oral diseases (USDHHS, 2000).

        Oral diseases affect individuals of all age groups and all backgrounds. Dental health problems start when people are young and become worse as they get older. Dental caries is the most prevalent chronic disease among children (Centers for Disease Control and Prevention, 2011). Twenty percent of children ages 2-5 years and 60% of children ages 5-17 have dental caries (Centers for Disease Control and Prevention, 2011). One quarter of elderly Americans ages 65 and older have become edentulous (with no teeth) (Centers for Disease Control and Prevention, 2011).

        According to a data from the 2011-2012 National Health and Nutrition Examination Survey, 91% of adults ages 20-64 had dental cavities and 21% of them had no treatment for the dental caries. This survey has also found that 20% of adults ages 65 and older had untreated dental cavities (Dye et al., 2015).

        The prevalence rate of oral cancer has increased among American adults aged 40-59 (Pytynia, Dahlstrom, & Sturgis, 2014) but it is concentrated among older people with median age of 62 (Howlader et al., 2013). In 2012, almost 7,890 oral

cancer deaths were recorded and the majority of them were among patients aged 65 and older (Howlader et al., 2013).

According to the report on oral health from the U.S. Surgeon General, poor oral health has an impact on physical, social, and economic health of people (USDHHS, 2000). This project also noted that, due to oral diseases or dental visits, students lose more than 51 million school hours and employees miss 164 million hours of work each year (USDHHS, 2000). Moreover, poor dental health has an undesirable impact on speech and nutrition (USDHHS, 2000) and may cause improper appearance that may lead to social isolation and loss of self-esteem (Benyamini, Leventhal, & Leventhal, 2004).

The major causes of oral health problems include lack of access to dental services and the high cost of dental care services (Pew Center on the States, 2010). There are three main factors causing limited access to dental care. These include an uneven distribution of dentists and a small number of dentists who accept Medicaid (The Pew Charitable Trusts, 2013), and shortages in dentists supply (USDHHS, 2014) .

In the United States, low-income people and those who live in rural counties have a harder time accessing dental care services compared to other groups (USDHHS, 2000). In addition, "too few dentists are willing to provide care to low-income populations, older adults, and people with disabilities", as the U.S. Senate Committee on Health, Education, Labor and Pensions mentioned in their report (2012). Americans with higher incomes have better oral health than those with lower incomes (Pew Center on the States, 2010).

Supply and Demand for Dentists

An adequate dentist supply is important to meet dental care needs of the U.S. population and improve access to dental services. The dentist to population ratio in most of Australia's largest states is 1 per 2,000 (Tennant, Kruger, & Shiyha, 2013). According to the World Health Organization (WHO), in Africa, the dentist to population ratio is almost 1:150,000 compared to about 1:2,000 in most developed nations (2016). The U.S. Department of Health and Human Services recommends a dentist to population ratio of 1 to 5,000 or 1 to 4,000 if there is a high need for dental services (USDHHS, 2014). Based on the recommended ratio, there are 4,900 Dental Health Professional Shortage Areas (DHPSAs) in the United States and 7,300 new dentists are needed to eliminate the scarcity of dentists supply (USDHHS, 2014). In 2015, more than 46 million people in the United States had no access to oral health care services because they lived in a DHPSA (USDHHS, 2015).

The U.S. Department of Health and Human Services published national and state-level projections of dental care providers in the U.S. by the year 2025. According to this report, the number of dentists required to meet the need for dental care services is expected to be higher than the number of dentists available, which will worsen the current shortage (USDHHS, 2015). The report also projected that while in 2012 there were 190,800 active dentists expected to increase to 202,600 by 2025, the actual demand for dentists by 2025 will be 218,200 – an estimated shortage of over 15,000 dentists nationwide (USDHHS, 2015). This report also estimated that while all 50 states and the District of Columbia are expected to have a shortage of dentists in 2025, the greatest shortages are expected

to take place in California, Florida, and New York (USDHHS, 2015). This shortage in dentist supply reduces access to dental care providers for underserved communities who don't seek oral health care because of different reasons including lack of proximity to a dentist, inability to afford dental care services, and limited knowledge about the importance of oral health (USDHHS, 2015).

Dental insurance is important to increase access to dental care and improve utilization of dental services. By increasing the number of enrollees in Medicaid through the implementation of Affordable Care Act (ACA), the number of beneficiaries from dental insurance is estimated to increase by 15% for children and 5% for adults by 2018 (USDHHS, 2015). However, the increase in dental insurance enrollees may not solve the problem of access to dental care services because all states may not accept the Medicaid expansion (USDHHS, 2015) and also the dental benefits provided to adults include only emergency and other services limited to some diagnostic, preventive, and minor restorative procedures (Nasseh, Vujicic, & O'Dell, 2013).

Around 130 million Americans have no dental insurance (National Association of Dental Plans, 2009). Often, private insurance plans do not cover dental benefits, and those who provide dental coverage require high deductibles and co-payments (Agency for Healthcare Research and Quality, 2004). This makes dental care hard to afford for low and middle income individuals (Agency for Healthcare Research and Quality, 2004).

Rural versus Urban Areas

In the United States, urban areas have a higher percentage of dentists (The National Advisory Committee, 2004), better access to dental care, and lower rates of dental caries and permanent tooth loss compared with rural populations (Wall & Brown, 2007). Also, a report from the National Center for Health Statistics has noted that "the supply of dentists in relation to population generally decreases as urbanization decreases" (2001).

Rural adults have worse oral health outcomes, as they are more likely to have untreated dental cavities, to be edentulous, and less likely to have private dental insurance than adults living in urban areas (Vargas, Dye, & Hayes, 2002). There are numerous factors contributing to these disparities in oral health between rural and urban populations. These factors include a low proportion of dentists, a lack of dentists accepting Medicaid, a lack of public transportation, geographic isolation, and indigence in rural areas (Bayne et al., 2013).

The National Advisory Committee on Rural Health and Human Services published a report noting that "Rural America has a higher percentage of elderly population, which is less likely to have dental coverage, as they generally are not employed and Medicare does not provide dental benefits." (2004).

There are other factors making the oral health of rural populations worse than their counterparts living in urban areas, including the use of non- fluoridated water and the high rate of using tobacco (USDHHS, 2000). Water fluoridation is more common in urban areas than rural areas (USDHHS, 2000). Using non-fluoridated water in rural areas puts rural populations at higher risk of having

dental caries. People living in rural counties have a higher rate of using tobacco than their counterparts in urban counties, which increases their risk of having oral health problems like oral cancer, periodontal diseases, and dental cavities (USDHHS, 2000).

As has been mentioned, poor oral health is not only associated with oral diseases, but also with medical conditions such as diabetes and health diseases. The main factors of bad dental health outcomes include the limited access to dental care and the high costs of dental services. The limited access to dental care is mainly caused by the uneven distribution of dentists, shortages in dentist supply, and low number of dentists who accept Medicaid. There are disparities in dentist supply in the United States, as the percent of dentists is greater in urban areas. Studies found that rural residents have a limited access to dental care, worse oral health outcomes, and a higher rate of poverty compared to people living in urban counties.

In this study, the supply of dentists per county in the state of Kentucky was examined to determine the underserved counties. In addition, the factors associated with the shortage of dentist supply, and the oral health outcomes were examined.

Objectives

The purpose of this project was to examine the supply of dentists in the Commonwealth of Kentucky at the county level. I determined which counties have shortages in dentist supply and examined factors associated with the counties with shortages. The county-level crude incidence and mortality rates of oral cancer and the percent of adults missing six or more teeth because of tooth decay or gum

disease, in each county, were analyzed to see if they are associated with dentist supply shortage. Based on findings, interventions to increase the number of dentists in underserved populations were recommended.

Measures

Several county-level variables were analyzed. These variables included the total number of dentists, total county population, dentist to population ratio, dentist supply shortage (shortage=1 and adequate=0), median household income in thousands, median age in years, percent of Medicaid enrollees, rurality (rural county=1 and urban county= 0), oral cancer crude incidence and mortality rates per 100,000 persons/100,000, and percent of adults missing six or more teeth.

Research questions and hypotheses

In this project, four research questions with corresponding hypotheses in regard to the factors and health outcomes associated with the shortage of dentist supply were developed. These questions and hypotheses included:

Q1: Do median household income, median age, rurality, and percent of Medicaid enrollees have an influence on shortages in dentist supply at the county level?

H_a: Having a lower median household income, a higher median age, more Medicaid enrollees, and being rural will increase the odds that a county will have a dentist shortage supply.

Q2: Is there a relationship between crude incidence rate of oral cancer and median household income, median age, percent of Medicaid enrollees, rurality, and shortage in dentist supply at the county level?

H$_a$: Counties with a lower median household income, a higher median age, more Medicaid enrollees, that are rural, and have a dentist shortage will have a higher crude incidence rate of oral cancer.

Q3: Is there a relationship between crude mortality rate of oral cancer and median household income, median age, percent of Medicaid enrollees, rurality, and shortage in dentist supply at the county level?

H$_a$: Counties with a lower median household income, a higher median age, more Medicaid enrollees, that are rural, and have a dentist shortage will have a higher crude mortality rate of oral cancer.

Q4: Is there a relationship between percent of adults missing six or more teeth and median household income, median age, percent of Medicaid enrollees, rurality, and shortage in dentist supply at the county level?

H$_a$: Counties with a lower median household income, a higher median age, more Medicaid enrollees, that are rural, and have a dentist shortage will have a higher percentage of adults missing six or more teeth.

Data and Methods

Data Collection

In this study, several data sets were combined for the analysis. These included:

- Number of dentists in 2014 (USDHHS- Area Health Resources Files).
- Total Population in 2014 (U.S. Bureau of Census).
- Median Household Income in 2014 (U.S. Bureau of Census).
- Median Age in 2014 (U.S. Bureau of Census).
- Rural and Urban counties (United States Department of Agriculture- Economic Research Service, 2013).
- Percent of Medicaid Enrollees in 2014 (Kentucky Department of Medicaid Services).
- Crude Incidence and mortality rates of oral cancer (2009-2013) (Kentucky Cancer Registry).

- Percent of adults missing six or more teeth (2012-2014) (Behavior Risk Factor Surveillance Service).

Data Analysis

Variables were analyzed in six separate steps for each county. First, a dentist to population ratio was calculated, using the number of dentists per county and total county population variables. To determine any shortages, ratios were compared to the ratio that is recommended by the U.S. Department of Health and Human Services (1 to 4000 for a dentist to population). This ratio is recommended when there is a high need for dental care services. I used it because I think people in Kentucky have a high need for dental services. Children in Kentucky have a high rate of dental caries compared to children in the other states (Chattopadhyay, Arevalo, & Cecil, 2008). In addition, Kentucky has a high prevalence rate of cigarette smoking among adults compared to adults nationwide (Centers for Disease Control and Prevention, 2012). To create a dentist supply shortage variable, the ratios were converted to decimals. The recommended dentist to population ratio (1 to 4000) was converted to 0.00025 (1/4000). Any county whose dentist to population ratio was higher than 0.00025 was identified as adequate and any with a ratio equal or lower than 0.00025 were identified as having a shortage (shortage=1 and adequate=0).

Second, to determine the association between the variables, the dentist supply shortage, median household income, median age, percent of Medicaid enrollees, rurality, crude incidence and mortality rates of oral cancer, and percent of adults missing six or more teeth variables were analyzed utilizing a correlation matrix.

To determine rurality, the 2013 Rural-Urban Continuum Codes (RUCCs) were used. RUCCs classify counties as metropolitan/urban and non-metropolitan/rural on a scale of one to nine (1 to 3= urban and 4 to 9= rural) based on population size, adjacency to a metropolitan area, and degree of urbanization (USDA Economic Research Service, 2013). Based on this classification, I coded the rurality variable as: rural counties=1 and urban counties=0.

The Kentucky Department of Medicaid Services has a monthly report for the number of Medicaid enrollees per county (Kentucky Cabinet for Health and Family Services, 2016). To compute the percent of Medicaid enrollees, I calculated the average number of beneficiaries for 2014 per county and then compared it to the total population in a county.

Multicollinearity was assessed by computing the variance inflation factor (VIF). Multicollinearity becomes problematic if VIF values exceed 10 and tolerance is less than 0.10 (Belsley et al., 2005).

Lastly, four regression models were utilized to determine the factors impacting the shortage of dentist supply, the incidence rate of oral cancer, the mortality rate of oral cancer, and the percent of adults missing six or more teeth (Table 1). The regression models are outlined in the table below.

Table 1. Description of Regression Models.

Type of Model	Dependent Variables	Independent Variables
Logistic Regression	Dentist supply shortage	Median Household Income, Rurality, Median Age, and Percent of Medicaid Enrollees

Multiple Regression	Crude incidence rate of oral cancer	Median Household Income, Rurality, Median Age, Percent of Medicaid Enrollees, and Dentist Supply Shortage.
Multiple Regression	Crude mortality rate of oral cancer	Median Household Income, Rurality, Median Age, Percent of Medicaid Enrollees, and Dentist Supply Shortage
Multiple Regression	Percent of adults missing six or more teeth	Median Household Income, Rurality, Median Age, Percent of Medicaid Enrollees, and Dentist Supply Shortage

Note: Oral incidence and mortality rates of counties with less than 5 cases were not reported.

Results

In 2014, forty-two of the 120 counties in Kentucky had a shortage in dentist supply (see Appendix) and Owsley and Robertson counties had no dentists at all.

Descriptive Statistics

Counties with shortages in dentist supply had a slightly higher median age, a higher percent of Medicaid enrollees and adults missing six or more teeth. However, they had a lower income and lower oral cancer mortality rate compared to those who with an adequate supply of dentists. Both of them had almost the same incidence rate of oral cancer.

In addition, rural counties had a higher median age, a higher percentage of Medicaid enrollees and adults missing six or more teeth, higher incidence and

mortality rates of oral cancer, and a lower median household income compared to urban counties (Table 2).

Bivariate Analysis

Correlation matrix analysis

A correlation matrix was run to evaluate the relationship between the variables, which included shortage in dentist supply, median household income, percent of Medicaid enrollees, median age, rurality, oral cancer incidence rate per 100,000, oral cancer mortality rate per 100,000, and percent of adults missing six or more teeth. Some variables were significantly associated. There was a positive relationship between shortage in dentist supply and median age. In addition, median household income was negatively associated with percent of Medicaid enrollees, median age, rurality, and percent of adults missing six or more teeth. Moreover, there was a positive relationship between percent of Medicaid enrollees and median age, rurality, and percent of adults missing six or more teeth (Table 3).

Multicollinearity Assessment

Variance inflating factor was computed to test muticollinearity. None of the independent variables were highly correlated (none of the independent variables were predicted by the other independent variables) (VIF < 3 and Tolerance > 0.13).

Multivariate Results

Logistic regression model

A logistic regression model was run to determine the impact of the independent variables, which included percent of Medicaid enrollees, median household income, median age, and rurality, on shortage of dentist supply. There were significant relationships among the variables in the model (Prob > chi2= 0.0009). The shortage of dentist supply was positively impacted by median age and negatively impacted by rurality. For every one-year increase in age, the odds of a county to have shortage in dentist supply increase by 43% (p=0.00). In addition, being a rural county decreases the odds of a county to have shortage in dentist supply by 71% (p=0.05) (Table 4).

Ordinary Least Square Regression models

A multiple regression model was run to determine the impact of the independent variables, which included percent of Medicaid enrollees, median household income, median age, rurality, and shortage in dentist supply, on oral cancer incidence rate.

There were no significant relationships among the variables in the model (Prob > F= 0.5318) and none of the independent variables had a significant impact on the incidence rate of oral cancer (Table 5).

A multiple regression model was run to determine the impact of the independent variables, which included percent of Medicaid enrollees, median

household income, median age, rurality, and shortage in dentist supply on oral cancer mortality rate.

There were no significant relationships among the variables in the model (Prob > F= 0.3206) and none of the independent variables had a significant impact on the mortality rate of oral cancer (Table 6).

A multiple regression model was run to determine the impact of the independent variables, which included percent of Medicaid enrollees, median household income, median age, rurality, and shortage in dentist supply on percent of adults missing six or more teeth. There was a significant relationship among the variables in the model (Prob > F= 0.0000) and 61% of the variation in percent of adults missing six or more teeth in a county is explained by percent of Medicaid enrollees, median household income, median age, rurality, and shortage in dentist supply (Adjusted R-square= 0.6174).

Percent of Medicaid enrollees, median household income, and median age had significant impact on percent of adults missing six or more teeth.   On average, each percent increases in Medicaid enrollees was associated with a 0.31% increase in adults missing six or more teeth (p=0.00) and each one thousand dollar increases in household income was associated with a 0.0003% decrease in adults missing six or more teeth in a county (p=0.00).   In addition, each one-year increase in age causes 0.36 increase in the percent of adults missing six or more teeth in a county (p=0.05), 0n average (Table 7).

Discussion

The results of this project showed that 42 of the 120 counties in Kentucky had a shortage in dentist supply during 2014 and two counties had no dentist at all. The overall ratio of dentist to population in Kentucky was 1:1,743, which was better than what the U.S. Department of Health and Human Services recommends (1 to 4000) (USDHHS, 2014). Therefore, at the state level, there was no shortage in dentist supply. However, there was uneven distribution of dentists, which made 35% of the counties in Kentucky have shortages in dentist supply. Results also showed that rural counties were less likely to have a shortage in dentist supply, opposing my hypothesis. This finding was also inconsistent with results reported by the U.S. Department of Health and Human Services that noted that the majority of areas that have shortage in dentist supply are rural (USDHHS, 2015).

The results of this study showed that the counties with higher median age were more likely to have shortages in dentist supply which is relevant to what the U.S. Senate Committee on Health, Education, Labor and Pensions noted in their report. They reported that "too few dentists are willing to provide care to older adults" (2012). The reason behind that could be because elderly populations are less likely to have dental coverage as they are generally retired and Medicare doesn't provide dental benefits (The National Advisory Committee, 2004). Therefore, dentists may prefer to practice in areas with a larger population of children and adults. As people get older, they become more likely to have poor oral health (Centers for Disease Control and Prevention, 2011). This study also found that the counties with higher median age are more likely to have a higher percent of

adults missing six or more teeth, supporting my hypothesis. Oral health problems among older adults are not limited to missing teeth. An earlier study noted that the prevalence and mortality rates of oral cancer are higher among older adults (Howlader et al., 2013).

Result showed that the Kentucky counties with lower median incomes had more citizens missing six or more teeth. This result was expected and consistent with an earlier report stating that higher-income populations have better oral health outcomes than those with lower-income, as one of the major factors leading to an improper oral health outcomes in a community is the high cost of dental care services (Pew Center on the States, 2010).

There several consequences of missing six or more teeth on the physical and social status of individuals. Missing teeth may limit the ability of speech and lead to undesirable appearance which may cause affected individuals to be socialy isolated. Also, it imapcts the general health of individuals by limiting nutrition choices because of the chewing problems that missing teeth may develop. In addition, missing teeth may weaken the jaw bone and cause other teeth to move which leads to occlusion (contact between upper and lower teeth) problems. Moreover, early missing of primary teeth among chidren may cause delayed eruption of premanent teeth.

Providing dental benifits through Medicaid is optional for State governments, as they may limit the amount of dental services or do not cover any dental benefit at all (Haley et al., 2008). "While most states provide at least emergency dental

services for adults with Medicaid, less than half of states provide coverage for other types of dental care" (U.S. Senate Committee on Health, Education, Labor, and Pension, 2012). The dental services provided to adults who are eligible for Medicaid are limited to emergency and some diagnostic, preventive, and minor restorative procedures (Nasseh, Vujicic, & O'Dell, 2013). The State of Kentucky Medicaid Dental Program covers limited services for adults. These services include oral exams, emergency visits, x-rays, extractions, and fillings, but do not cover other services like root canal therapy, crowns, braces, dentures, or implants (Kentucky Department for Medicaid Services, 2015).

As has been noted, counties with higher lower median income, more Medicaid enrollees, and higher median age had a greater percent of adults missing six or more teeth. Older people are also less likely to have dental coverage and the counties with higher median age were more likely to have shortages in dentist supply. Therefore, it is important to increase dental benefits among low-income and older citizens because they were more likely to have poor oral health outcomes. In addition to the high cost of dental services and the limited dental benefits covered by Medicaid, the small number of dentists who accept Medicaid, because of the low rate of reimbursement, plays an important role in limiting access to dental care (The Pew Charitable Trusts, 2013). Therefore, increasing the rate of reimbursement for dentists may improve the access to dental care (U.S. Senate Committee on Health, Education, Labor, and Pension, 2012).

In addition, the number of dentists should be increased in the Kentucky counties that had shortages in dentist supply to improve access to dental care. The

Appalachian Dental Loan Forgiveness program is a good project to limit the shortage. It rewards new dental graduates, who practice in underserved counties, by reducing their loan debts. Two dentists were rewarded in 2015 for practicing in Whitley and Floyd counties. I think requiring applicants for loans, among dental students, to serve for at least a year in counties with shortages in dentist supply, as a condition for providing them with the loans would be a potential solution to decrease the shortages.

Limitations

This study had a number of limitations that may affect the results reported. These include that not all the data sets were issued in the same year. However, they were the most recent available data. Also, the data reported for oral cancer incidence and mortality rates were not complete. Some of the counties had no data available, as oral incidence and mortality rates of counties with less than 5 cases were not reported. In addition, this project was not examining the real impact of the independent variables on the dependent variables that outlined in Table 1 but evaluating the association between them because most of the data were limited to one year.

Future studies in the same area of this project may find more consistent data available and avoid the potential impact of these limitations.

Conclusion

As has been mentioned, 42 counties in Kentucky had shortages in dentist supply during 2014 and counties with higher median age and that were urban were

more likely to have inadequate supply of dentists. In addition, counties with higher median age and lower median income had a higher percent of adults missing six or more teeth. Based on these results, public health practitioners should intervene and propose policies to improve access to dental services for older and low-income groups in Kentucky and increase the number of dentists in the underserved counties in order to improve access to dental care and prevent oral health problems.

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Appendix

The counties that have shortages in dentist supply include Adair, Allen, Ballard, Bath, Bracken, Breckinridge, Butler, Carlisle, Casey, Clay, Crittenden, Cumberland, Edmonson, Fulton, Gallatin, Henry, Hickman, Larue, Lawrence, Lewis, Lincoln, Livingston, Lyon, Marshall, Martin, McCreary, McLean, Meade, Menifee,

Mercer, Metcalfe, Owsley, Pendleton, Powell, Robertson, Rockcastle, Spencer, Todd,

Trigg, Trimble, Webster, and Wolfe.

Table 2. Descriptive statistics.

	All counties (Mean/percent/total)	Counties with adequate dentist supply (Mean/total)	Counties with shortage in dentist supply (Mean/total)	Rural counties (Mean/percent)	Urban counties (Mean/percent)
Median age	40	39	41	40	38
Median household income	$38,264	$39,222	$36,485	$34,344	$47,784
Medicaid enrollees	33%	31%	35%	37%	23%
Adults missing six or more teeth	29%	28%	30%	31%	23%
Oral cancer incidence rate per 100,000	16.61	16.60	16.65	16.89	15.96
Oral cancer mortality rate per 100,000	2.10	2.35	1.64	2.34	1.57
Rural counties	85	55	30		
Urban counties	35	23	12		

Table 3. Correlation matrix analysis.

	Shortage in dentist supply	Median household income	Percent of Medicaid enrollees	Median age	Rurality	Oral cancer incidence rate per 100,000	Oral cancer mortality rate per 100,000	Percent of adults missing six or more teeth
Shortage in dentist supply	1.0000							
Median household income	-0.1374	1.0000						
Percent of Medicaid enrollees	0.1406	-0.7384*	1.0000					
Median age	0.3218*	-0.2807*	0.2885*	1.0000				
Rurality	0.0096	-0.6431*	0.5143*	0.3355*	1.0000			
Oral cancer incidence rate per 100,000	0.0036	-0.0271	0.0448	0.1753	0.0710	1.0000		
Oral cancer mortality rate per 100,000	-0.1172	-0.0068	-0.0160	-0.1123	0.1179	0.1064	1.0000	
Percent of adults missing six or more teeth	0.1094	-0.7086*	0.7541*	0.3275*	0.4461*	0.1331	0.0002	1.0000

*= Significant association

Table 4. Logistic regression analysis.

Shortage in dentist supply	Odds ratio	P-value	[95% Conf. Interval]
Percent of Medicaid Enrollees	1.01	0.63	0.96 – 1.06
Median household income	0.99	0.34	0.99 – 1.00
Median age	1.43	0.00	1.16 – 1.77
Rurality	0.29	0.05	0.08 – 1.01
Constant	2.13	0.00	1.62 – 0.03

Number of observations= 120   LR chi2= 18.80   Prob > chi2= 0.0009

Table 5. Multiple regression analysis.

Oral cancer incidence rate	Coefficient	P-value	[95% Conf. Interval]
Percent of Medicaid Enrollees	1.08	0.87	-1.22 – 1.44
Median household income	3.52	0.71	-1.56 – 2.26
Median age	4.20	0.07	-3.40 – 8.74
Rurality	4.20	0.79	0.00 – 0.00
Shortage in dentist supply	-6.69	0.58	-0.00 – 0.00
Constant	-0.00	0.85	-0.00 – 0.00

Number of observations= 120   F= 0.83   Prob > F= 0.5318

Adjusted R-square= -0.0072

Table 6. Multiple regression analysis.

Oral cancer mortality rate	Coefficient	P-value	[95% Conf. Interval]
Percent of Medicaid Enrollees	-8.32	0.79	-7.17– 5.51
Median household income	1.92	0.67	-7.20 – 1.10
Median age	-1.48	0.17	-3.65 – 6.88
Rurality	0.00	0.07	-1.34 – 0.00
Shortage in dentist supply	-3.63	0.53	-0.00 – 8.04
Constant	0.00	0.17	-0.00 – 0.00

Number of observations= 120   F= 1.19   Prob > F= 0.3206

Adjusted R-square= 0.0077

Table 7. Multiple regression analysis.

Percent of adults missing six or more teeth	Coefficient	P-value	[95% Conf. Interval]
Percent of Medicaid Enrollees	0.3184355	0.00	0.21 – 0.43
Median household income	-0.0003059	0.00	0.00 – 0.00
Median age	0.3666029	0.05	-0.002 – 0.73
Rurality	-1.55604	0.24	-4.18 – 1.07
Shortage in dentist supply	-0.8452163	0.40	-2.82 – 1.14
Constant	16.60	0.04	0.27 – 32.94

Number of observations= 120   F= 39.41   Prob > F= 0.0000

Adjusted R-square= 0.6174

Biographical sketch

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