

Are there Rural-Urban Differences in Dentist Supply?

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Abstract

Objective: To examine the supply of dentists in the Commonwealth of Kentucky at the county level. Also, to assess the association between the percent of adults missing six or more teeth and the shortage in dentist supply, in each county.

Methods: Secondary data analysis was used. Several county-level datasets were combined for the analysis. Binary logistic analysis was used to assess the association between shortage in dentist supply and rural and urban counties. Multiple linear regression analysis was utilized to examine the relationship between percent of adults missing six or more teeth and shortage in dentist supply, controlling for potential confounders.

Results: Out of the 120 counties in Kentucky, 42 counties had shortages in dentist supply, and two counties had no dentists at all. Urban counties were marginally associated with a shortage in dentist supply. Counties with higher median age were more likely to have a shortage in dentist supply. Also, this study showed that counties with higher household income were significantly associated with less percent of adults missing six or more teeth.

Conclusion: Public health practitioner should intervene and propose policies to improve access to dental services for older and low-income groups and underserved counties in Kentucky.

Keywords: Kentucky; Dentist; Supply; Shortage; Urban; Rural; Counties

Introduction

According to 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 dental caries. This survey has also found that 20% of adults ages 65 and older had untreated dental cavities [1].

The major causes of oral health problems include lack of access to dental services and the high cost of dental care services [2]. There are three main factors causing limited access to dental care. These include uneven distribution of dentists and a small number of dentists who accept Medicaid [3] and shortages in dentists supply [4].

Low-income people and those who live in rural counties have a harder time accessing dental care services compared to other groups [5]. Also, "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 [6]. Americans with higher incomes have better oral health than those with lower incomes [2].

An adequate dentist supply is essential to meet the dental care needs of the U.S. population and improve access to dental services. 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 [4]. 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 [4]. 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 [7].

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 [7]. 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 [7]. 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 [7].

Dental insurance is important to increase access to dental care and improve the 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 [7]. 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 [7] and also the dental benefits provided to adults may include only emergency and other services limited to some diagnostic, preventive and minor restorative procedures [8].

Around 130 million Americans have no dental insurance [9]. Often, private insurance plans do not cover dental benefits, and those who provide dental coverage require high deductibles and co-payments. This makes dental care hard to afford for low- and middle-income individuals [10].

In the United States, urban areas have a higher percentage of dentists [11], better access to dental care, and lower rates of dental caries and permanent tooth loss compared with rural populations [12]. Also, a report from the National Center for Health Statistics has noted that “the supply of dentists in relation to the population generally decreases as urbanization decreases” [13].

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 [14]. Numerous factors are 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 [15].

The purpose of this project was to examine the county level supply of dentists in the Commonwealth of Kentucky. Counties that have shortages in dentist supply were determined, and the association between the underserved counties and rurality was examined. Also, the association between the percent of adults missing six or more teeth because of tooth decay or gum disease, in each county, and dentist supply shortage was assessed. County-level demographic and socioeconomic factors were examined.

Methods

Data collection

This is an ecological study among the 120 counties in the state of Kentucky. Several county-level datasets were combined for the analysis. The data included the 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 [16], percent of Medicaid enrollees in 2014 (Kentucky Department of Medicaid Services), and percent of adults missing six or more teeth (2012 - 2014) (Behavior Risk Factor Surveillance Service).

Data analysis

The variables in this study included the 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), and percent of adults missing six or more teeth due to tooth decay or gum disease.

Variables were analyzed in four 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. We used it because we 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 other states [17]. In addition, Kentucky has a high prevalence rate of cigarette smoking among adults compared to adults nationwide [18]. 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 equal or higher than 0.00025 was identified as adequate, and any with a ratio lower than 0.00025 was identified as having a shortage (shortage = 1 and no shortage = 0).

Second, to determine rurality, the 2013 Rural-Urban Continuum Codes (RUCCs) were used. RUCCs classifies counties as metropolitan/urban and nonmetropolitan/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 [16]. Based on this classification, we coded the rurality variable as rural counties = 1 and urban counties = 0.

Third, The Kentucky Department of Medicaid Services has a monthly report for the number of Medicaid enrollees per county [19]. To compute the percent of Medicaid enrollees, we calculated the average number of beneficiaries in 2014 per county was calculated and then compared it to the total population in a county.

Lastly, two regression models were utilized to determine the factors associated with the shortage of dentist supply, and the percent of adults missing six or more teeth (Table 1). The regression models are outlined in the table below.

Type of Model	Dependent Variable	Independent Variables
Logistic Regression	Dentist supply shortage	Rurality, Median Household Income, Median Age, and Percent of Medicaid Enrollees.
Multiple Regression	Percent of adults missing six or more teeth	Dentist Supply Shortage, Rurality, Median Household Income, Median Age, and Percent of Medicaid Enrollees.

Table 1: Description of regression models.

The statistical software STATA version 14.0 was used to analyze the data and calculate odds ratios and estimates for the outcomes. The statistical significance level was set at $P < 0.05$.

Results

In 2014, 42 (35%) of the 120 counties in Kentucky had a shortage in dentist supply (See appendix) and, Owsley and Robertson counties had no dentists. The majority of the counties were rural (71%). Counties with shortages in dentist supply had a slightly higher median age compared to those with no shortage in dentist supply. Rural counties had a higher median age, a higher percentage of Medicaid enrollees and adults missing six or more teeth, and a lower median household income compared to urban counties (Table 2).

Characteristics	All counties N = 120	Rural counties N = 85 (71%)	Urban counties N = 35 (29%)	P-value	Counties with shortage in dentist supply N = 42 (35%)	Counties with no shortage in dentist supply N = 78 (65%)	P-value
Age (years)	39.7 (2.72)	40 (2.3)	38 (3)	0.0002	41 (2.4)	39 (2.7)	0.0003
Household income	38,264 (9,539)	34,343 (6,277)	47,784 (9,458)	< 0.0001	36,484 (8,247)	39,222 (10,088)	0.1344
Medicaid enrollees (%)	32.7 (12.3)	36.7 (12)	22.8 (5.5)	< 0.0001	35 (12.6)	31.4 (11.9)	0.1256
Adults missing six or more teeth (%)	28.5 (7.8)	30.7 (7.5)	23 (5.7)	< 0.0001	29.6 (7.3)	27.8 (8.1)	0.2343
Counties with shortage in dentist supply							
Yes	42 (35)	30 (35)	12 (34.29)				
No	78 (65)	55 (65)	23 (65.71)	0.9162			

Table 2: Descriptive statistics for Kentucky population in each of the groups of interest*.

*Values are given as mean (SD) for continuous variables and n (%) for categorical variables. P-values are given from corresponding t-tests for continuous variables, and Pearson Chi-square test for categorical variables.

Table 3 depicts the results from the binomial logistic regression analysis. Holding all else in the model constant, being a rural county decreases the odds of a county to have shortage in dentist supply by 71% (p = 0.05). In addition, a one-year increase in age was associated with a 43% increases in the odds of a county to have shortage in dentist supply (p = 0.001).

Variable	Odds Ratio	Standard Error	P-value
Rurality	0.2908558	0.1845663	0.052
Percent of Medicaid Enrollees	1.011822	0.0249992	0.634
Median household income	0.9999635	0.0000388	0.347
Median age	1.428994	0.1541615	0.001

Table 3: Results from the binomial logistic regression model*.

*Dependent variable of interest: Shortage in dentist supply (yes = 1, no = 0). Independent variable of interest: Rurality (rural counties = 1, urban counties = 0).

Table 4 presents the results from the multiple linear regression analysis. Sixty-one percent of the variation in percent of adults missing six or more teeth in a county was explained by percent of Medicaid enrollees, median household income, median age, rurality, and shortage in dentist supply (Adjusted R-square = 0.6174). After adjusting for other variables in the model, on average, a ten percentage-point increase in Medicaid enrollees was associated with a 3.1% increase in adults missing six or more teeth (p = 0.001) and each \$10,000 increase in household income was associated with a 0.003% decreases in adults missing six or more teeth in a county (p = 0.001). In addition, each ten years increase in age was associated with 3.6 increases in the percent of adults missing six or more teeth in a county (p = 0.05).

Variable	Estimate	Standard Error	P-value
Shortage in dentist supply	-0.8452163	1.001631	0.401
Rurality	-1.55604	1.329045	0.244
Percent of Medicaid Enrollees	0.3184355	0.0543711	0.0001
Median household income	-0.0003059	0.0000783	0.0001
Median age	0.3666029	0.1859183	0.051

Table 4: Results from the multiple linear regression model*.
 *Dependent variable: Percent of adults missing six or more teeth. Independent variable of interest: Shortage in dentist supply (yes = 1, no = 0).

Discussion

The results of this study found that the overall ratio of dentist to the population in Kentucky in 2014 was 1:1,743, which was better than what the U.S. Department of Health and Human Services recommends (1 to 4000) [4]. Therefore, at the state level, there was no shortage in dentist supply. However, there was an uneven distribution of dentists, which made 35% of the counties in Kentucky have a shortage in dentist supply. Results also showed that rural counties were less likely to have a shortage in dentist supply. This finding was inconsistent with results reported by the U.S. Department of Health and Human Services that noted that the majority of areas that have a shortage in dentist supply are rural [7].

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” [6]. 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 [11]. Therefore, dentists may prefer to practice in areas with a larger population of children and adults. This study also found that the counties with higher median age are more likely to have a higher percentage of adults missing six or more teeth. 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 [20].

Kentucky counties with lower median incomes had more citizens missing six or more teeth. This result was 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 improper oral health outcomes in a community is the high cost of dental care services [2].

Providing dental benefits through Medicaid is optional for State governments, as they may limit the number of dental services or do not cover any dental benefit at all [21]. “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” [6]. The dental services provided to adults who are eligible for Medicaid are limited to emergency and some diagnostic, preventive, and minor restorative procedures [8]. 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 treatment, crowns, braces, dentures, or implants [22].

This study had some limitations that may affect the results reported. The limitations include that not all the data sets were issued in the same year. However, they were the most recent available data. Also, this project was not examining the real impact of the independent variables on the dependent variables that outlined in table 1 but examining 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.

As has been noted, counties with higher lower median income and higher median age had a greater percentage 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 [3]. Therefore, increasing the rate of reimbursement for dentists may improve access to dental care [6].

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. 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.

Conclusion

As has been mentioned, 42 counties in Kentucky had shortages in dentist supply during 2014, and two counties had no dentist at all. Also, counties with higher median age and that were urban were more likely to have an inadequate supply of dentists. In addition, counties with a lower household income had a higher percentage 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 to reduce oral health problems.

Appendix

The counties that have shortage 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.

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