Original Contributions

Relationship between community-level variables and number of general dentists

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ABSTRACT

Background. In this study, the authors used observational data from 2014 to evaluate the association between the number of general dentists and several community characteristics.

Methods. The authors collected community-level characteristics from secondary sources for all 947 Iowa incorporated communities to study their relationships with the mean number of general dentists per 1,000 population per square mile (population density), the dependent variable. The authors used zero-inflated negative binomial models to examine the association between the dependent and predictor variables.

Results. Only 22.8% of communities had a dentist. Urban, young, well-educated, fluoridated communities with at least 1 elementary school had the highest estimated mean concentration of dentists. Isolated communities with older, less educated adults and lacking fluoridation and an elementary school had the fewest dentists.

Conclusions. Although population is an important determinant for where a dentist practices, other variables such as urbanization, demographic characteristics, fluoridation status, and presence of at least 1 elementary school are also predictors of the number of dentists in a community.

Practical Implications. These findings provide dental students and young practitioners useful information by highlighting community characteristics that are associated with office locations.

Key Words. Dentist; population; rural population; population density; rural spatial distribution; educational status; socioeconomic factor.

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There is no 1 perfect formula for deciding the ideal dental practice location for everyone. However, each person pursues a hierarchical inductive decision process, generally based on family ties, familiar geographic knowledge, and personal goals. Often, providers also make a first cut about suitable practice location communities on the basis of population, natural amenities, potential population growth, and provider competition (that is, potential market share). Providers then might refine their community options on the basis of such items as availability of ancillary personnel, proximity to suppliers, local ordinances and zoning codes, local taxes, and overall safety. Once dentists select a community, they generally review potential sites that are reasonably accessible, have sufficient parking, are convenient, are near other businesses and services that may draw similar clientele, and, in larger communities, have reasonable foot traffic. Selecting an office location is a high-stakes process and involves a long-term investment that is too important and costly to change easily once an office opens.

Although empirical research results have demonstrated that the number of dentists and physicians in a community generally increases concurrent with population size, this association is somewhat imperfect, indicating that other factors also influence practice site location.[1,2] Few study investigators have analyzed other community-level variables that may be important in the selection process. For example, investigators have conducted demand threshold analysis at the county level to determine adequacy to support a dental practice.[3] Demand threshold analysis is based on Christaller's[4] central place theory, which explains spatial arrangement, size, and number of communities within a geographic region and which can be applied to determine the minimum size of a market to support an economic activity.[5]

Demand threshold analysis is useful for studying the minimum requirements in less urbanized areas to support a single business within a geographic location.[6-9] Using this method to evaluate the US dental workforce, Nash[3] found associations between the number of dentists in a county with population, per capita income, and several county-level characteristics, including commuting time to work, education levels, and median age. The number of dentists in a county was associated positively with the county population and per capita income. Other statistically significant characteristics related to the number of local dentists included, but were not limited to, population density, percentage who were college educated, median age, and whether the county was adjacent to a metropolitan area. At a more granular level, investigators in a 1992 study of Connecticut townships found that population and per capita income were associated positively with the number of dentists, whereas the price for office space was associated negatively.[10]

Investigators in other studies have used different approaches to address market forces that appear to affect practice location. Solomon[11] performed discriminant analysis to investigate several demographic and socioeconomic characteristics in determining whether 1 or more general dentists are located in a ZIP code. He found 10 variables that had a varying degree of association with whether a general dentist practiced in a ZIP code, with population being but 1 variable. Likewise, Wall and Brown[12] found that market forces, including population size and income generally, influence where practices are located, even in rural areas. Rural counties lacking a dentist usually had an insufficient population, low per capita income, or both.

In this observational cross-sectional study, we evaluated community-level characteristics in relationship with the number of general dentists in Iowa communities. We hypothesized that other variables besides population, such as educational attainment and the presence of essential community services, are associated with the number of dentists in a community.

METHODS

Iowa, with a population of slightly more than 3 million residents, served as the focus of this study. The 2014 edition of the Iowa Dentist Tracking System, a monitoring system of the Office of Statewide Clinical Education Programs, University of Iowa Carver College of Medicine, was the source for each dentist's primary practice location. Each practice is contacted at least semiannually to update its status about its primary location, practice arrangement (that is, solo, associates, group practice, and so on), dentists in the practice, and hours worked per week for each dentist. Further information about the tracking system is available elsewhere.[13] In 2014, there were 1,134 active general dentists in Iowa. We geocoded each practice location at the street level and then identified the corresponding community, town, or city.

We considered the following variables for inclusion as predictors of the number of general dentists in a community: household income, educational level, age, degree of rurality, county seat status, water fluoridation status, and the presence of an elementary school, which may be considered an essential community service.[14] We collected median age, median household income, and percentage of the adult population older than 25 years who had earned at least a bachelor's degree for each incorporated community from the previous 5-year American Community Survey period (years 2010-2014). Population and land area (that is, square miles) were based on 2014 US Census Bureau estimates.[15]

The Centers for Disease Control and Prevention website was the primary source for determining community fluoridation status.[16] If the community was not listed in the online database, we searched online for the water company associated with that community. If the website did not include the fluoridation status, we contacted the water company to verify the status for that particular community. We found public elementary school data at the National Center for Education Statistics website.[17] We categorized each community by using the Rural-Urban Commuting Area (RUCA) code.[18] We then converted RUCA codes to 1 of 4 community categories: urban, large rural, small rural, and isolated (categorization A) on the basis of the ZIP code with the highest level of urbanization in that community.

We performed univariate descriptive statistics to explore the distribution of the variables in all of the communities (N = 947). Statistical tests for bivariate associations between the number of general dentists per 1,000 population per square mile (population density), the dependent variable, and each of the potential community-level predictor variables followed. Because of the large number of communities with 0 dentists (n = 731), we used zero-inflated negative binomial (ZINB)

ABBREVIATION KEY

RUCA: Rural-Urban Commuting Area.
ZINB: Zero-inflated negative binomial.