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Article

Preventive dental care and systemic health outcomes: Expanding Medicaid dental coverage and usage

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SUMMARY

Medicaid coverage has been shrinking in many states. As a result, several benefits have been reduced or eliminated, including preventive dental care. However, preventive dental care is crucial for many Medicaid recipients because poor dental health is linked to serious systemic conditions, including cardiovascular disease. We hypothesized that the lack of preventive dental care in Medicaid programs leads to higher healthcare costs for socioeconomically vulnerable populations due to increased rates of dental disease, tooth loss, oral infections, as well as poorer systemic health outcomes related to cardiovascular disease and diabetes-related complications. This study examined the relationship between dental care access, the prevalence of cardiovascular disease and other chronic diseases, and socioeconomic indicators, with a specific focus on suburban Cook County, Illinois, USA. This region was selected due to its demographic diversity and availability of detailed public health data, making it a representative case study of systemic health disparities of those with Medicaid. Using publicly available health and socioeconomic data, we assessed the potential impact of Medicaid expansion to fully cover preventive dental care on high-risk populations. We found that expanding Medicaid to include preventive dental care in all states, as well as encouraging usage of pre-existing dental benefits, could enhance overall public health and reduce lifetime healthcare expenditures.

INTRODUCTION

Medicaid is the United States of America's largest public health insurance program. It supports 70 million low-income Americans to access healthcare. Federal law sets minimum eligibility for Medicaid which is determined by household income, age, and categorical qualifications such as pregnancy, disability and children in qualifying families. But its terms differ across each state (1). Dental care, in particular, varies widely across each state in terms of Medicaid coverage (2). Although all children enrolled in Medicaid, regardless of state, receive dental care ranging from preventive care to emergency procedures, adults enrolled in Medicaid receive care based on the regulations of the state they reside in. As of 2024, 34 states offer dental benefits and eight states provide limited emergency care, including extractions and dentures; and nine states provide no adult dental coverage (2,3). Additionally, the coverage is not consistent across the country, as states commonly reduce or remove dental benefits when facing budgetary constraints (4).

As some states, such as Alabama and Mississippi, exclude preventive care in their Medicaid plans, the risk for severe dental problems as well as further health complications increases (5). Poor oral health is correlated with higher risk for serious systemic conditions, such as cardiovascular diseases, respiratory diseases, kidney diseases, and cancer (6,7). Many of these conditions cause mortality, particularly cardiovascular disease, which is the leading cause of death in the United States (8). A previous study found that people with periodontal disease were 3.5 times more likely to develop atherosclerotic cardiovascular disease (9). However, the role of preventive dental care in an individual's overall health is less widely recognized.

In this study, we examined publicly available data to understand how preventive dental care is correlated to health conditions and outcomes, as well as socioeconomic factors. We hypothesized that the lack of preventive dental care in Medicaid programs contributes to poorer overall health outcomes, and more risk for vulnerable populations. Illinois, where this study took place, offers extensive coverage including preventive dental care (10). Even though Illinois offers these benefits, they are not being fully utilized for many reasons that this study will further explore. We chose Cook County as the focus for this study because of the widely available public health data and demographic diversity. Our study supports a correlation between preventive dental care and improved health outcomes. Expanding Medicaid preventive dental care coverage and education on how to access these resources could play a crucial role in improving public health.

RESULTS

Population Based Health and Socioeconomic Variables at the Community Level

We compiled data from the Cook County Health Atlas, which included health and socioeconomic information of 4,070,735 individuals from 143 zip codes in suburban Cook County, Illinois during 2019-2022 (11). We chose Cook County because of the availability of open-source information about residents. We used the Pearson correlation coefficient, *r*, to find the strength of relationships between dental visits or doctor visits for routine checks with variables such as all teeth lost in seniors, fair/poor self-reported health, heart failure-related hospitalization rate, hardship index, and Social Vulnerability Index (SVI) etc. The definition and data source for these variables are listed in the MATERIALS AND METHODS section. Many of these variables measure the percentage of the population in a particular zip code, for example, the percentage of residents who visited the dentist or dental

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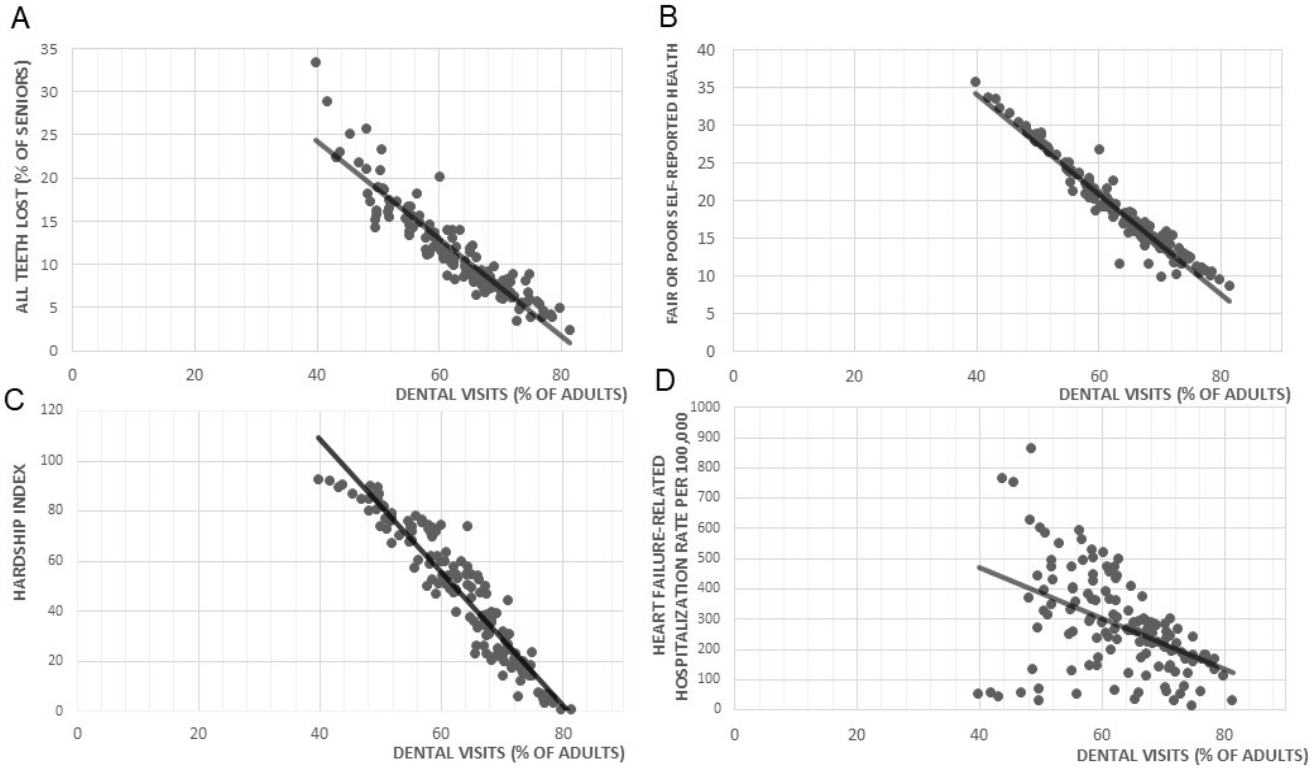


Figure 1. Relationship between dental visits and health outcomes. Dental visit is defined as the percentage of adults 18 and over who reported visiting a dentist or dental clinic within the last year. Health outcomes reported in panels A and B were obtained from the Behavioral Risk Factor Surveillance System (BRFSS, 2022). (A) The correlation with all teeth loss (defined as percent of resident adults aged 65 and older who report having lost all their natural teeth because of tooth decay or gum disease, r = -0.93, p<0.001, n=143). (B) The correlation with the percentage of resident adults with self-reported fair or poor health status (r = -0.97, p<0.001, n=143), in more than 14 days of the past 30 days. (C) The correlation with the Hardship index, obtained from the American Community Survey administered by the U.S. Census Bureau (2019-2023) (r= -0.95, p<0.001, n=143). (D) The correlation with heart failure-related hospitalization rate as inpatient hospitalization discharges per 100,000 (r=-0.46, p<0.001, n=139) based on Illinois Department of Public Health (IDPH) data of inpatient hospitalization discharges per 100,000 during 2016-2020.

clinic within the last year, heart-failure related hospitalization rate as inpatient discharges per 100,000 residents, and the percentage of residents who reported their physical health fair/poor. We examined the relationships between dental or medical visits and many different variables provided by the Cook County Health Atlas, but we have only chosen to discuss the variables with a more important correlation. A complete comparison of dental/medical visits and their association with all the variables in the dataset is provided in **Appendix Table 1**.

Correlation between Dental Visits and Health Disparities

We first assessed the correlation between the percentage of adults who had dental visits within the past year and the percentage of older adults (65+) who lost all their natural teeth because of tooth decay or gum disease from each zip code community. Using the Pearson correlation coefficient, we determined that the percentage of residents who had dental visits had a strong negative correlation with all teeth lost (r=-0.93, p<0.001, n=143, **Figure 1A**), which suggests an inverse association between dental care utilization and complete tooth loss among older adults at the community level. Next, we assessed the correlation of dental visit with other variables. There was a strong negative correlation between dental visits and self-reported fair/poor health (r=-0.97, p<0.001, n=143, **Figure 1B**), which was determined as percentage of residents in an area who reported their health was fair or poor out of five categories: excellent, very good, good, fair, or poor. Dental visits had a very strong negative correlation with hardship index (i.e., a score based on unemployment, age dependency, education, per capita income, crowded housing, and poverty) (r=-0.95, p<0.001, n=143, **Figure 1C**). We also noted a moderate negative association with multiple health related variables including heart failure-related hospitalizations (i.e., age-adjusted rate of inpatient hospital discharges; r=-0.46, p<0.001, n=139, **Figure 1D**), stroke mortality rate, chronic kidney disease morbidity, chronic obstructive pulmonary disease morbidity, and heart disease mortality rate (**Appendix Table 1**). Notably, our analysis showed no clear correlation between transportation and dental visits, which was similar to the correlation between transportation and doctor visits (r=-0.06, p=0.43, and r=0.11, p=0.16, respectively, n=143) (**Appendix Table 1**). This means that transportation is not the main barrier to receiving dental care.

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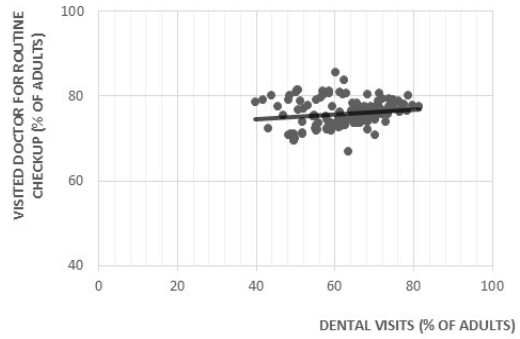


Figure 2. Relationship between dental visits and doctor visits for routine checkup. Doctor visit is defined as the percentage of adults visited for routine checkup within the last year. The correlation coefficient between dental visits and doctor visits is r = 0.17, p<0.05, n=143.

Evidence of Effective Government Policy in Medical but Not Dental Care in Low Socioeconomic Populations

In our dataset, we noticed that more people had medical care compared to dental care. The percentage of adults who visited the doctor for routine checkups remained uniformly higher (range from 66.8% to 85.7%) across all zip codes of variable socioeconomic status when compared with the percentage of adults who visited dentists (range from 39.8% to 81.4%). We hypothesized that this is due to the wide availability of government-supported insurance on medical care, but not so much on dental care. We wanted to examine the correlation between medical care and dental care, and whether the difference was statistically significant or not. We observed a very weak but still significant correlation between dental visits and routine doctor visits (r = 0.17, p<0.05, n=143; **Figure 2**). To further investigate whether the difference we observed between dental and doctor visits was not due to random chance, we performed a student's paired t-Test, with a two-tailed distribution. The differences observed between dental (M= 63.1, SD= 8.9, n=143) and doctor visits (M= 75.9, SD= 3.08, n=143) were statistically significant (p<0.001).

The Cook County Health Atlas uses a measurement called Social Vulnerability Index (SVI) which is a composite index that maps social vulnerability to health stressors such as disease outbreaks, natural disasters, and other public health emergencies. This index uses variables from the US Census Bureau's American Community Survey data based on socioeconomic status, disability, minority status, housing and transportation. The higher the number, the more vulnerable the population is. Dental visits demonstrated a strong negative correlation with the SVI (r = -0.94, p<0.001, n=119; **Figure 3A**) as well as percentage of people below

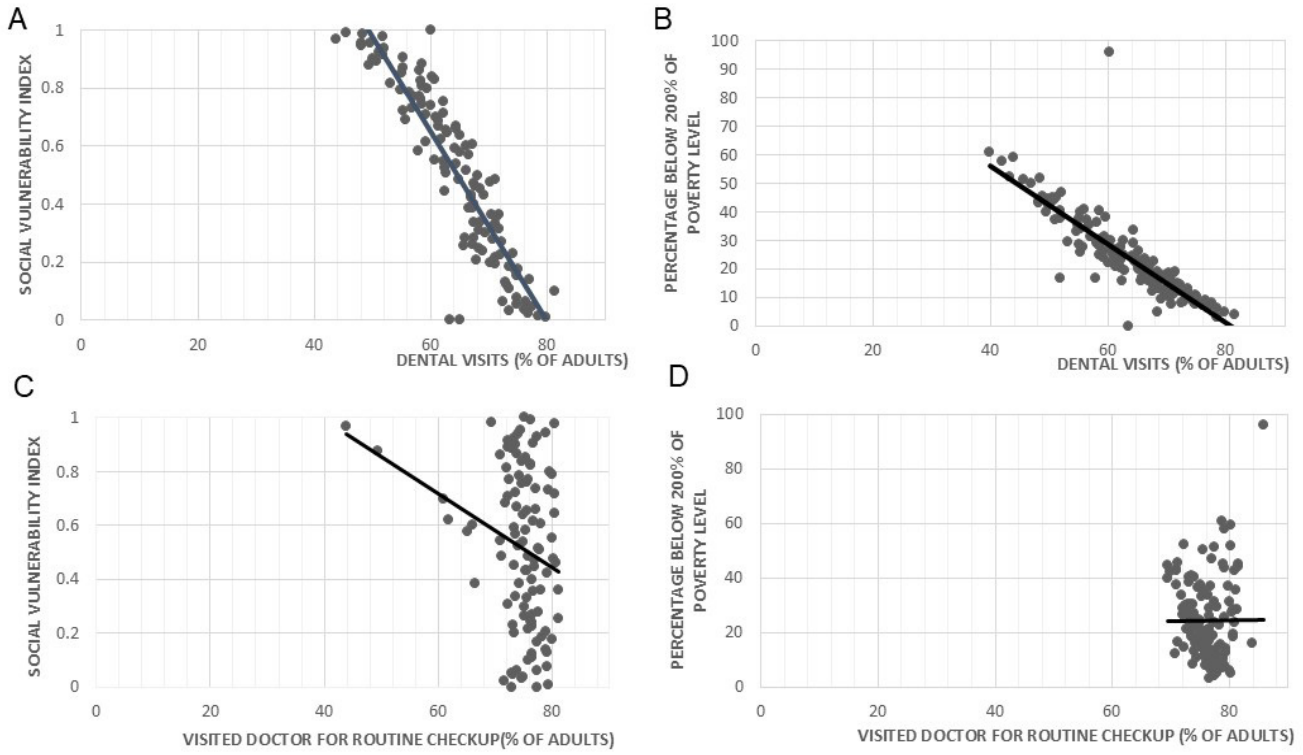


Figure 3. Relationship between either dental or doctor visits and Social Vulnerability Index (SVI) or percentage of people below 200% of the federal poverty line. (A) The correlation between dental visits and SVI which ranges from 0 [least vulnerable] to 1 [most vulnerable] (r=-0.94, p<0.001, n=119). (B) The correlation between dental visits and percentage of individuals in families that are below 200% of the federal poverty level based on past 12 months income (r=-0.86, p<0.001, n=142). (C) The correlation coefficients between doctor visits and SVI (r=-0.19, p<0.05, n=119). (D) The correlation coefficients between doctor visits and the percentage of individuals below 200% of the federal poverty line (r=0.01, p=0.94, n=142). Data on SVI and percentage of individuals in families below 200% of the federal poverty level were obtained from American Community Survey (ACS 2019-2023).

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200% of the federal poverty line (r = -0.86, p<0.001, n=142; **Figure 3B**), indicating an inverse relationship between dental care utilization and social vulnerability/poverty. However, we observed a very weak negative correlation between routine medical checkups and the SVI (r = -0.19, p<0.05, n=119; **Figure 3C**), and there was no correlation with the percentage of people below 200% of the federal poverty line (r = 0.01, p=0.94, n=142; **Figure 3D**). Medical Checkups were relatively more equitable across SVI Levels.

Dental Care Showed a Stronger Correlation to Improved Overall Health than Routine Medical Visits

In this study, we identified that dental visits had a moderate negative correlation with health outcomes with which medical visits had no significant association, including all teeth lost, chronic obstructive pulmonary disease (COPD) morbidity, chronic kidney disease morbidity, heart failure-related hospitalization rate, etc. (**Appendix Table 1**). For example, dental visits had a negative correlation with stroke mortality rate per 100,000 population (r=-0.49, p<0.001, n=130; **Figure 4A**), which indicated that communities with higher rates of preventive dental visits tended to have lower stroke mortality rates. Doctor visits for routine checkups, however, were only weakly correlated with stroke mortality rate (r = 0.19, p<0.05, n=130; **Figure 4B**), indicating higher rates of routine doctor visits tended to have slightly higher stroke mortality. When we looked at overall well-being, there was a very strong negative correlation between dental visits and the percentage of adults whose physical health is not good measured through self-assessment (r = -0.91, p<0.001, n=143; **Figure 4C**). However, there was no correlation between doctor visits and the percentage of adults whose physical health is not good (r = -0.03, p=0.7, n=143; **Figure 4D**). Collectively, these findings suggested that preventive dental visits were more consistently associated with population health indicators than routine doctor visits in this dataset.

DISCUSSION

In this population-based study, we provided evidence that there was a strong association between dental visits and improved overall health, while routine medical visits did not show the same degree of association with improved overall health. We have provided some evidence for expanding Medicaid coverage and usage for preventive dental care that could be impactful for an individual's overall well-being, particularly in low socioeconomic populations.

We observed that the percentage of adults who visited the doctor for routine checkups remained uniformly higher across all zip codes of variable socioeconomic status when compared with the percentage of adults who visited dentists. The likelihood of an individual visiting a healthcare provider can be influenced by government support, such as Medicaid

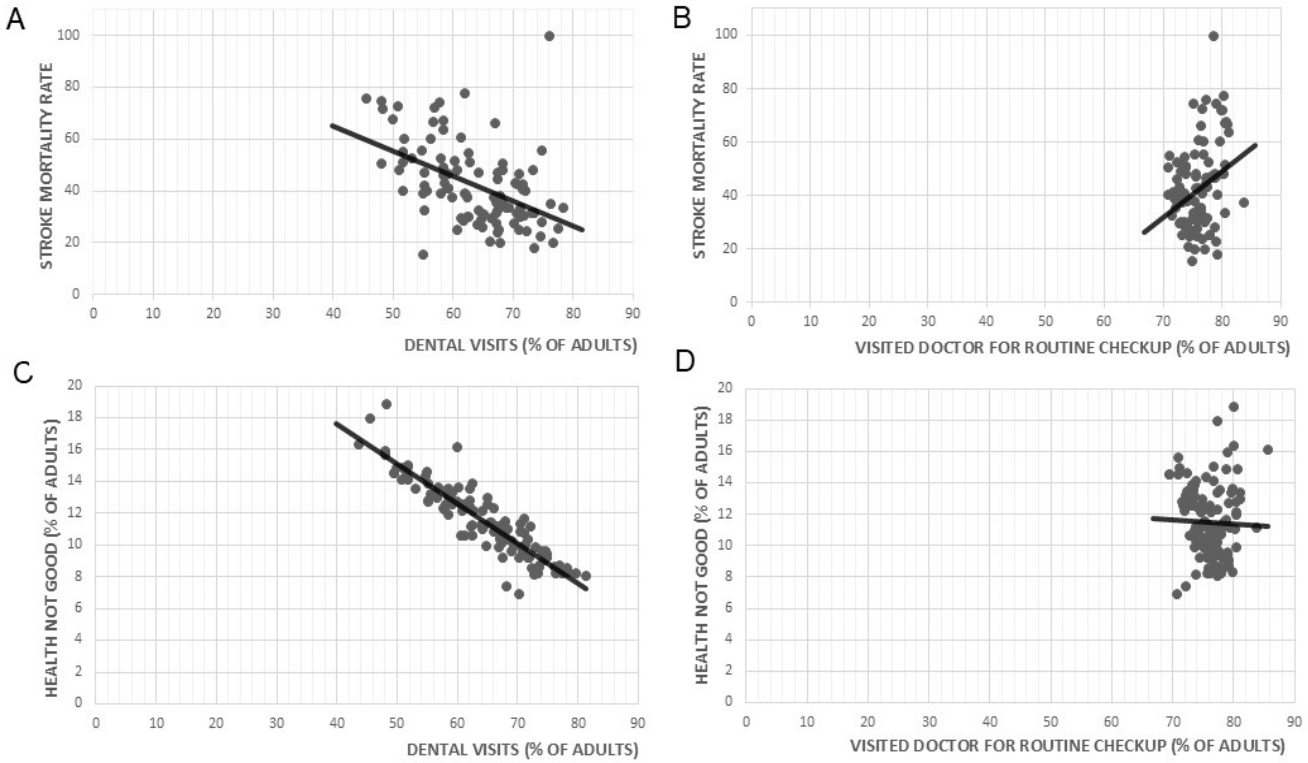


Figure 4. The relationship between dental or medical visits and health outcomes. (A) The correlation coefficient between dental visits (r = -0.49, p < 0.001, n=130) and the stroke mortality rate, defined as the number of residents died from stroke, per 100,000 population from the Illinois Department of Public Health (IDPH) Vital Records (https://dph.illinois.gov/data-statistics/vital-statistics, 2018-2022). (B) The correlation coefficient between doctor visits (r = 0.19, p<0.05, n=130) and the stroke mortality rate. (C) The correlation between dental visits (r = -0.91, p<0.001, n=143) and the percentage of adults whose physical health is poor or fair according to the BRFSS (2019). (D) The correlation between doctor visits (r = -0.03, p=0.7, n=143) and the percentage of adults whose physical health is poor or fair according to the BRFSS (2019).

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(1). This suggested that government programs, such as Medicaid, may help support access to medical care among lower socioeconomic populations and equalize accessibility across different levels of socioeconomic groups. For example, there was a strong negative correlation between dental care and SVI, as well as the percentage of people below the poverty line, suggesting that individuals in more socially vulnerable communities were less likely to access dental care. However, there was no significant correlation between medical checkups and SVI, or poverty. Although these two types of healthcare utilization are influenced by the same socioeconomic determinants such as SVI and poverty, doctor visits were more structurally protected due to government policy. Utilization of these two types of healthcare was only weakly correlated, although the correlation was significant. Notably the percentage of adults who visited the doctor was consistently higher than the percentage of adults who visited the dentist in all zip codes, indicating that medical care utilization consistently outpaced dental care utilization as a whole. This gap widened particularly in more disadvantaged zip codes (based on SVI and poverty rate) with lower dental visits while medical visits remained relatively stable. This suggests that a government subsidized health insurance program covering routine checkups in low socioeconomic populations may positively impact healthcare utilization. From this study, we observed effective government policy in medical coverage has substantially equalized routine medical care across socioeconomic levels, while the exclusion or underutilization of dental care from Medicare continues to make it inaccessible by social vulnerability and poverty.

Our data showed that higher rates of dental visits were associated with lower stroke mortality rates. This is consistent with literature that shows that poor oral health, especially gum disease, is associated with an increased risk of heart disease due to inflammation and bacteria entering the bloodstream (6, 9). Interestingly, dental visits demonstrated a stronger correlation with overall health than routine doctor visits. Though this could be influenced by accessibility, insurance coverage, socioeconomic status and other confounding factors, we may also take into account that dental visits are preventive measures that directly improve oral health (12), while doctor visits are routine checkups that assess general health and may not significantly modify one's health (13). Therefore, preventive dental care could contribute to better oral conditions, which may, as a result, be associated with improved overall health, particularly in low socioeconomic populations.

Poor oral health is linked to higher incidence of diseases, such as cardiovascular diseases, respiratory diseases, and kidney diseases (14-16). As a result, people covered by Medicaid who reside in states that do not have dental coverage or have limited dental coverage may be more susceptible to cardiovascular disease, the leading cause of death in the US, as well as other health issues (17). Emergency dental care for extractions or treatment of abscesses in a dental office setting depends on individual state policy (18). But emergency dental care delivered in the emergency department (ED) is covered by Medicaid in all states as a mandatory Medicaid benefit under federal law (2). Therefore, there could be a higher incidence of ED visits in states without preventive dental care, and thus it may be more costly to overall healthcare expenditure supported by taxpayers. An expansion of Medicaid to cover preventive care will likely reduce risk for these diseases and could lead to saving money on emergency care.

Although expansion of preventive dental care can come with increased expenditures and investment in these programs, it eventually leads to better oral health and more benefits in health beyond oral disease (19). A study from 2015 reported that the global costs of oral diseases were estimated at $298 billion for treatment and $144 billion in productivity losses (20). A published economic evaluation reported that preventive dental care programs, such as the Childsmile program in Scotland, can save money, where costs fell from £8.8 million to £4.8 million over a period of 8 years (21). While Childsmile focuses on children and may not be directly comparable to adult Medicaid populations, a study of adults enrolled in Medicaid found that preventive dental visits in the prior year led to fewer treatment visits thereafter and lower total spending on dental services (22). Using New York State Medicaid data, one study showed that more preventive dental care visits were associated with lower healthcare facility utilization, including a 3% drop in the relative risk for ED visits and a 9% decrease in inpatient admissions (23). Based on these data, each preventive dental care visit is associated with a reduction of healthcare costs by $235.64 per member, and reduction of inpatient care costs by $181.39 per member (23). There is thus evidence that expanding Medicaid to cover preventive dental care is associated with reduced healthcare expenditures, both in dental costs and broader medical costs.

Healthcare costs can be reduced via implementation of preventive dental care in socially vulnerable populations, but this expansion must also come with education. Some states, including the state of Illinois, have full coverage of preventive dental care, yet these resources are not being utilized, particularly in lower socioeconomic populations, as evidenced in our study. We found that government-supported doctor visits had a higher percentage of use even in low socioeconomic settings, while dental visits, which are also government-supported in the state of Illinois, were not consistently utilized by the same population. There could be many reasons for this, such as not all dental clinics accepting Medicaid, difficulty scheduling a time that fits patients' busy workdays, or not knowing about dental coverage at all. It is possible that there is a lack of awareness, specifically about the importance of dental care. Many people in this population may deprioritize preventive dental care until there is an emergency. Awareness of the importance of oral health, as well as places to receive Medicaid-covered treatment, is key to improving public dental health and ensuring that resources are being used. Our analysis showed that transportation is not the main barrier to receiving dental care. The access issue may stem from not having the time for dental visits. In order to combat this issue, a program for after-hour clinics could be created. These clinics could offer convenient care with flexible times to allow workers to receive dental care without taking out a large portion of their day. To many clinics, treating patients on Medicaid is not profitable, discouraging many private clinics from taking in Medicaid patients (24). In 2024, Medicaid dental reimbursement averaged at 49.8% of private insurance reimbursement levels, although rates

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differed widely by states and was as low as 16.8% in New Hampshire (24). Dentist Medicaid participation is substantially lower than physician participation (25). In many states, the majority of Medicaid recipients are of minority demographic groups, introducing challenges such as language or cultural barriers (26). The dental workforce tends to be primarily White or Asian, with Hispanic and Black dentists being underrepresented (27). However, Hispanic and Black people make up a higher percentage of Medicaid recipients than of the U.S. population (28). Diversification of dentistry, creating a dental workforce of more people from minority groups, could ease these problems and increase accessibility of care for these groups (29).

All these factors may contribute to poor access due to underutilization of preventive dental care, even in states that include preventive care in their Medicaid plans. Future efforts should focus on identifying and addressing these patient-, provider- and system-level barriers to increase the utilization of preventive dental services. To address the barriers to creating greater access to preventive dental care, policymakers should consider increasing Medicaid reimbursement rates, improving patient outreach and education on the importance of preventive dental care, expanding provider participation, and diversifying dental workforce.

This study has several limitations. It is mainly an observational correlational study and cannot imply causation. Although we cannot fully determine causality, it provides insight into potential public health patterns. The dataset lacks information on all possible confounding factors, which may affect the results. For example, many factors such as income, education, age, race, and diet could all influence how often residents visit the dentist and how healthy they are overall. Thus, it is hard to know which factor is the determining factor. The data and conclusions drawn from this analysis are based on a small regional population and may not be representative of the entire state or country.

In conclusion, this study found fewer dental visits in comparison to doctor visits, particularly in socially vulnerable populations. There was a correlation between preventive dental care and improved health outcomes, yet Medicaid coverage for preventive dental care is not fully being utilized. Analysis of this large dataset collected by government agencies and academic institutions provided strong real-life, population-based evidence for health policy making. While direct causality cannot be confirmed without further studies, the data advocates that expanding Medicaid preventive dental care coverage could play a crucial role in improving public health and reducing lifetime healthcare expenditures. However, public health is complex, and this study does not address all the factors. Increasing education about the importance of dental care may increase the utilization of these resources, and the implementation of more after-hours clinics will increase accessibility.

MATERIALS AND METHODS

Data Search

Publicly available data was downloaded from the Cook County Health Atlas. The Cook County Health Atlas is a data platform providing health, socioeconomic, and environmental data for Cook County (excluding Chicago), allowing users to explore demographics, and community health data (11). This database compiles data from 2019-2022, of a total population of 4,070,735 individuals from 143 zip codes in suburban Cook County (11). Suburban Cook County was chosen because it represents a mix of urban and suburban populations with varying socioeconomic conditions (30), making it a valuable model for national trends. This data encompassed health information collected by government agencies and academic institutions including the Illinois Department of Public Health (IDPH), National Center for Health Statistics, U.S. Small-Area Life Expectancy Estimates Project, Behavioral Risk Factor Surveillance System (BRFSS), American Community Survey (ACS, 2019-2023), U.S. Department of Agriculture Food Access Research Atlas, Health Resources & Services Administration, Environmental Protection Agency, National-Scale Air Toxics Assessment, and the Centers for Disease Control and Prevention (CDC). In this dataset, the median age for the entire population was 41.0. This varied by race, with median ages of 50.4 for White, 40.6 years for Black, 43.9 years for Asian, 30.6 years for Hispanic/Latino individuals, and 28 for individuals of two or more races. The population breakdown is as follows: white (49.77% of residents), black (15.73%), Asian (8.38%), Hispanic/Latino (23.02%), Native American (0.07%), Pacific Islanders/Native Hawaiian (0.02%), two or more races (2.62%). Median household income ranged from $100,913 for Hispanic/Latino households to $103,459 for White households, and $116,803 for households identifying as two or more races. According to the 2020 U.S. Census data, this dataset from suburban Cook County exhibited a similar median age and similar racial/ethnic distribution to the entire U.S. as a whole, but with a slightly higher median household income (31).

Defined Variables

We selected the following variables from Cook County Health Atlas (11) and have defined them as follows. Dental visits are the percentage of resident adults aged 18 and older who report having been to the dentist or dental clinic in the previous year, provided by the BRFSS. Visited doctor for routine checkups (Doctor Visits) is the percentage of resident adults aged 18 and older who report having been to a doctor for a routine checkup (e.g., a general physical exam, not an exam for a specific injury, illness, condition) in the previous year. All teeth lost is the percent of resident adults aged 65 and older who report having lost all of their natural teeth because of tooth decay or gum disease, provided by the PLACES Project (a collaboration between CDC, the Robert Wood Johnson Foundation (RWJF), and the CDC Foundation (CDCF)). Fair/poor self-reported health is the percentage of residents in an area who answered fair or poor to the question “Would you say that in general your health is—Excellent, Very good, Good, Fair, Or Poor?", provided by the BRFSS. Heart failure-related hospitalization rate is the age-adjusted rate of inpatient hospital discharges. Hardship index is a composite score reflecting hardship in the community (higher values indicate greater hardship). It incorporates unemployment, age dependency (the percentage of the population that is dependent on others), education, per capita income, crowded housing, and poverty into a single score that allows for comparison between geographies. It is highly

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correlated with other measures of economic hardship, such as labor force statistics, and with poor health outcomes; this data is compiled by the ACS (32). The Social Vulnerability Index (SVI) ranks geographies in the suburban Cook County according to housing type and transportation determined by the following variables: (a) multi-unit structures, (b) mobile homes, (c) crowding, and (d) no vehicles, and (e) group quarters, collected by the Centers for Disease Control and Prevention (CDC) (33).

Statistical Analysis

We used the Pearson correlation coefficient, *r*, to find the strength of relationships between variables. The primary variable of interest was dental visits, defined by the Cook County Health Atlas as the percentage of adults aged 18 years and older who reported visiting a dentist or dental clinic within the past year. We analyzed the correlation coefficient between the primary variable and other socioeconomic and public health indicators. As Medicaid covers routine doctor visits, we used the percentage of the population that visited the doctor for a routine checkup as our secondary variable. This was used to assess the accessibility and reach of the Medicaid program, as well as to compare differences potentially attributed to the presence of a government-subsidized insurance program. The Pearson correlation coefficient ranges from -1 to +1, with the + sign representing positive correlations and - signs representing negative correlation. If *r* was ±0.1 - ±0.3, it was classified as a weak correlation. When *r* was ±0.3 - ±0.5, it had a moderate correlation. *r* = ±0.5 - ±0.75 was defined as strong, and *r* = ±0.75 - ±1.0 was considered very strong. Analysis was performed using Microsoft Excel. We calculated the *p*-value for Pearson's correlation, based on correlation coefficient and sample size (*n*) with the formula:

$$t = r \sqrt{\frac{n - 2}{1 - r^2}}$$

Then, we use a t-distribution function with degrees of freedom to find the two-tailed probability to assess the significance of the correlation.

To evaluate whether the difference between dental and doctor visits is statistically significant, we performed a Student's paired t-Test, with a two-tailed distribution, and calculated the probability that there is no difference in the means of these two groups.

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APPENDIX 1

	Correlation (r) with Dental visits (% of adults), 2022	p value	Visited doctor for routine checkup (% of adults), 2022	p value
Fair or poor self-reported health (PLACES) (% of adults), 2022	-0.974026357	p<0.001	-0.020031595	p=0.81
Hardship Index (0 [lowest] to 100 [greatest] hardship), 2019-2023	-0.947809751	p<0.001	-0.164419525	p<0.05
Tax returns with Earned Income Tax Credit (% of returns), 2021	-0.939572541	p<0.001	0.045318643	p=0.59
Social Vulnerability Index (SVI) -- Socioeconomic Status (0 [lowest] to 1 [highest] vulnerability), 2020	-0.935229227	p<0.001	-0.189319332	p<0.05
All teeth lost (PLACES), 65 and older (% of seniors), 2022	-0.928159222	p<0.001	0.030053841	p=0.72
Physical health not good (PLACES) (% of adults), 2019	-0.910035207	p<0.001	-0.034905175	p=0.70
Rental Assistance Priority Index, 2020	-0.898371117	p<0.001	-0.114930729	p=0.17
Below 200% of poverty level (% of residents), 2019-2023	-0.861023391	p<0.001	0.005654922	p=0.94
Food stamps (SNAP) (% of households), 2019-2023	-0.812561974	p<0.001	0.135405419	p=0.11
Poverty rate (% of residents), 2019-2023	-0.812354464	p<0.001	0.155853845	p=0.06
Social Vulnerability Index (SVI) (0 [lowest] to 1 [highest] vulnerability), 2020	-0.805983733	p<0.001	-0.147180727	P=0.11
Economic Diversity Index, 2019-2023	-0.798144879	p<0.001	-0.304288853	p<0.001
Uninsured rate (% of residents), 2019-2023	-0.741733346	p<0.001	-0.4963442	p<0.001
Deep poverty (% of residents), 2019-2023	-0.737836699	p<0.001	0.221662597	p<0.01
Social Vulnerability Index (SVI) -- Minority Status and Language (0 [lowest] to 1 [highest] vulnerability), 2020	-0.727604537	p<0.001	-0.204550509	p<0.05
Single-parent households (% of households), 2019-2023	-0.719338294	p<0.001	0.183640158	p<0.05
Chronic obstructive pulmonary disease (COPD) morbidity (PLACES) (% of adults), 2019	-0.6850496	p<0.001	0.132252429	p=0.15
Housing cost burden (% of occupied housing units), 2019-2023	-0.67916834	p<0.001	0.127121308	p=0.13
Chronic kidney disease morbidity (PLACES) (% of adults), 2019	-0.618954716	p<0.001	0.474515794	p<0.001
Severe housing cost burden (% of occupied housing units), 2019-2023	-0.611976845	p<0.001	0.290792654	p<0.001
Unemployment rate (%), 2019-2023	-0.608672768	p<0.001	0.120748594	p=0.15

Disconnected youth (% of residents aged 16-19), 2019-2023	-0.59121743	p<0.001	0.077185321	p=0.36
Crowded (% of occupied housing units), 2019-2023	-0.572779937	p<0.001	-0.513504777	p<0.001
Chronic kidney disease hospitalization rate (inpatient hospitalization discharges per 100,000), 2016-2020	-0.566690614	p<0.001	0.266525669	p<0.05
Vacant (% of housing units), 2019-2023	-0.534702237	p<0.001	0.240923024	p<0.01
Epilepsy-related ED visits (count of outpatient emergency department visits), 2018-2022	-0.515351618	p<0.001	-0.088998532	p=0.32
Stroke mortality rate (per 100,000 population), 2018-2022	-0.493228963	p<0.001	0.238288985	p<0.05
Proximity to Superfund sites (distance-weighted sites), 2024	-0.475524394	p<0.001	-0.066531083	p=0.50
Heart failure-related hospitalization rate (inpatient hospitalization discharges per 100,000), 2016-2020	-0.464452605	p<0.001	0.197031081	p<0.05
Chronic kidney disease hospitalizations (count of inpatient hospitalization discharges), 2016-2020	-0.458618936	p<0.001	0.21165632	p<0.05
Chronic kidney disease ED visitation rate (outpatient hospitalization discharges per 100,000), 2016-2020	-0.455525591	p<0.001	0.304062968	p<0.001
Particulate matter (PM 2.5) concentration (µg/m3), 2020	-0.439590829	p<0.001	0.126231567	p=0.13
Diesel particulate matter concentration (µg/m3), 2019	-0.438108864	p<0.001	-0.254322493	p<0.01
Chronic kidney disease ED visits (count of outpatient hospitalization discharges), 2016-2020	-0.423232198	p<0.001	0.309590079	p<0.001
Social Vulnerability Index (SVI) -- Housing Type and Transportation (0 [lowest] to 1 [highest] vulnerability), 2020	-0.410382303	p<0.001	-0.204900671	p<0.05
Ambulatory difficulty (% of residents), 2019-2023	-0.400805245	p<0.001	0.40449005	p<0.001
Proximity to hazardous waste management sites (distance-weighted sites), 2024	-0.387364089	p<0.001	-0.348450422	p<0.001
Cancer-related ED visits (count of outpatient hospitalization discharges), 2016-2020	-0.386610611	p<0.001	0.274895597	p=0.001
Disability (% of residents), 2019-2023	-0.385573261	p<0.001	0.365891045	p<0.001
Heart failure-related ED visits (count of outpatient hospitalization discharges), 2016-2020	-0.350237855	p<0.001	0.290094454	p<0.001

Prevalence of Housing Choice Vouchers (% of renter-occupied units), 2023	-0.344850692	p<0.001	0.510942637	p<0.001
Heart disease mortality rate (per 100,000 population), 2018-2022	-0.342404637	p<0.001	0.312019204	p<0.001
Stroke-related hospitalization rate (inpatient hospitalization discharges per 100,000), 2016-2020	-0.336848913	p<0.001	0.218650721	p<0.05
Heart failure-related ED visitation rate (outpatient hospitalization discharges per 100,000), 2016-2020	-0.317274933	p<0.001	0.382922261	p<0.001
Coronary heart disease morbidity (PLACES) (% of adults), 2022	-0.291545934	p<0.001	0.525098001	p<0.001
Potential lead paint indicator (% of housing units), 2019-2023	-0.28969128	p<0.001	-0.115977663	p=0.16
Population counts by demographic group (count of residents), 2019-2023	-0.258436838	p<0.01	-0.212995554	p=0.01
Traffic intensity (distance-weighted vehicles), 2020	-0.250582502	p<0.05	-0.049093813	p=0.56
Income Inequality Ratio (Ratio), 2019	-0.245137577	p<0.05	0.241409565	p<0.01
Coronary artery disease ED visits (count of outpatient hospitalization discharges), 2016-2020	-0.221731476	p=0.01	0.042570383	p=0.62
All cause mortality rate (per 100,000 population), 2018-2022	-0.197304567	p<0.05	0.332967134	p<0.001
Drive alone to work (% of workers 16 years and older), 2019-2023	-0.196308662	p<0.05	-0.226707248	p<0.01
Drive alone to work (% of workers 16 years and older), 2019-2023	-0.196308662	p<0.05	-0.226707248	p<0.01
Proximity to water polluting sites (distance-weighted facilities), 2021	-0.177017177	p<0.05	-0.019481251	p=0.81
Coronary artery disease hospitalization rate (inpatient hospitalization discharges per 100,000), 2016-2020	-0.171963906	p<0.05	-0.047579834	p=0.57
Mean travel time to work (minutes), 2019-2023	-0.170419004	p<0.05	0.3235987	p<0.001
Stroke-related ED visits (count of outpatient hospitalization discharges), 2016-2020	-0.143728132	p=0.13	0.104657422	p=0.26
Lifetime inhalation cancer risk (lifetime risk per million), 2019	-0.13301712	p=0.11	-0.169178956	p<0.05
Cancer-related hospitalization rate (inpatient hospitalization discharges per 100,000), 2016-2020	-0.094591024	p=0.26	0.153860492	p=0.07
Lung and bronchus cancer mortality rate (per 100,000 population), 2018-2022	-0.090967999	p=0.31	-0.039754073	p=0.66
Active transportation to work (% of workers 16 years and older), 2019-2023	-0.065601375	p=0.43	0.117137475	p=0.16

Foreign born (% of residents), 2019-2023	-0.051446383	p=0.54	-0.643857592	p<0.001
Coronary artery disease hospitalizations (count of inpatient hospitalization discharges), 2016-2020	-0.013841089	p=0.87	0.001682645	p=0.98
Cancer-related hospitalizations (count of inpatient hospitalization discharges), 2016-2020	-0.008924825	p=0.91	0.018485188	p=0.82
Social Vulnerability Index (SVI) -- Household Composition and Disability (0 [lowest] to 1 [highest] vulnerability), 2020	-0.004242696	p=0.96	0.431370689	p<0.001
Chronic liver disease and cirrhosis mortality rate (per 100,000 population), 2018-2022	-0.00148696	p=0.98	-0.140855547	p=0.19
Heart disease mortality (count of deaths), 2018-2022	0.006411588	p=0.94	0.040303432	p=0.63
Chronic liver disease and cirrhosis mortality (count of deaths), 2018-2022	0.006421843	p=0.94	-0.141002447	p=0.12
Influenza and pneumonia mortality rate (per 100,000 population), 2018-2022	0.061464553	p=0.52	0.009218854	p=0.93
Core preventive services (PLACES), Female (% of older adults), 2019	0.06446767	p=0.48	-0.169668716	p=0.06
Gini index of income inequality (0 [equality] to 100 [inequality]), 2019-2023	0.066146385	p=0.43	0.19974181	p<0.05
Stroke mortality (count of deaths), 2018-2022	0.099061495	p=0.24	0.059733062	p=0.52
Low food access (% of residents), 2019	0.211401618	p<0.05	0.283821375	p<0.001
Influenza and pneumonia mortality (count of deaths), 2018-2022	0.217883428	p<0.05	0.055202962	p=0.54
Coronary artery disease ED visitation rate (outpatient hospitalization discharges per 100,000), 2016-2020	0.274552894	p=0.001	-0.074019816	p=0.38
Primary care providers (PCP) per capita (physicians per 100,000 residents), 2011	0.30223789	p<0.001	0.273627443	p=0.001
Cancer-related ED visitation rate (outpatient hospitalization discharges per 100,000), 2016-2020	0.34174782	p<0.001	0.177903893	p<0.05
Median age, 2019-2023	0.518626241	p<0.001	0.543900093	p<0.001
Median gross rent, 2019-2023	0.572896622	p<0.001	0.303878259	p<0.001
Median home value, 2019-2023	0.703956228	p<0.001	0.162311481	p=0.05
Internet access (% of households), 2019-2023	0.71427249	p<0.001	0.047885589	p=0.57
Households in poverty not receiving food stamps (SNAP) (% of households below the poverty line), 2019-2023	0.763153419	p<0.001	0.06424491	p=0.45
High school graduation rate (% of residents), 2019-2023	0.779723755	p<0.001	0.396848716	p<0.001

Cholesterol screening (PLACES) (% of adults), 2021	0.789934794	p<0.001	0.668176658	p<0.001
Life expectancy (years), 2010-2015	0.813594114	p<0.001	-0.045692943	p=0.59
Per capita income, 2019-2023	0.819107413	p<0.001	0.249379259	p<0.01
Median household income, 2019-2023	0.824893979	p<0.001	0.175313675	p<0.05
Median property tax, 2019-2023	0.844687385	p<0.001	0.189692303	p<0.05
Population percentages by demographic group, Non-Hispanic White (% of residents), 2019-2023	0.859230573	p<0.001	-0.053523716	p=0.52
College graduation rate (% of residents), 2019-2023	0.883222587	p<0.001	0.276479263	p<0.001