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Does Medicaid Coverage Modify the Relationship between Glycemic Status and Teeth Present in Older Adults?

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Abstract

Understanding the relationships among diabetes, teeth present, and dental insurance is essential to improving primary and oral health care. Participants were older adults who attended senior centers in northern Manhattan (New York, N.Y.). Sociodemographic, health, and health care information were obtained via intake interviews, number of teeth present via clinical dental examinations, and glycemic status via measurement of glycosylated hemoglobin (HbA1c). Complete data on dental insurance coverage status for 785 participants were available for analysis (1,015 after multiple imputation). For participants with no dental insurance and any private/other dental insurance, number of teeth present is less for participants with diabetes than for participants without diabetes; however, for participants with Medicaid coverage only, the relationship is reversed. Potential

explanations include the limited range of dental services covered under the Medicaid program, inadequate diabetes screening and monitoring of Medicaid recipients, and the poor oral and general health of Medicaid recipients.

Keywords

Tooth; diabetes mellitus; health status disparities; dental care; insurance; Medicaid

The relationship of oral health to general health has been the focus of intense study. Periodontal disease has been identified as a risk factor for a number of non-communicable diseases. In particular, the bidirectional relationship between diabetes and periodontal disease has been documented in the scientific literature. Periodontitis is more severe in patients with diabetes^{1,2} and pre-diabetes³ than in others. Further, the presence of periodontitis has been associated with poor metabolic control, increased risk of long-term morbidity, and premature mortality.^{4,5}

These associations have focused attention on the need for oral health care providers to be aware of the glycemic status of their patients, as a thorough understanding of glycemic status is essential to appropriate patient management by dental providers, including treatment planning, patient ability to tolerate dental care, and outcomes of treatment. This is of particular importance for older adults, as the prevalence of diabetes and other non-communicable diseases increases with older age. It is also important that dental providers are aware of the dental insurance coverage status of their patients, as Medicare (a public insurance program for older adults) does not include dental insurance coverage except where medically necessary, and Medicaid (a public insurance program for economically disadvantaged and disabled persons) has variable and often limited dental insurance coverage for adults on a state-by-state basis.

Recent data from the U.S. Centers for Disease Control and Prevention indicate that the proportion of the U.S. population with diabetes is 4.1% for individuals between the ages of 20 and 44 years, 16.2% for individuals between the ages of 45 and 64 years, and 25.9% for individuals ages 65 years and older.⁶ Recently, there has been interest in the identification of undiagnosed and poorly managed dysglycemia (pre-diabetes and diabetes) in dental settings.⁷⁻⁹ This interest is driven in part by the aging of the U.S. population, increased tooth retention by older adults, the consequential augmented need for oral health services by older adults, and a variety of oral manifestations of diabetes.¹⁰

The *ElderSmile* program of the Columbia University College of Dental Medicine is a community-based approach to screening older adults for oral diseases in community settings, largely based in senior centers in northern Manhattan, New York, N.Y.¹¹⁻¹⁵ The program began with visits to senior centers by dental school faculty and trainees to provide information about oral hygiene procedures, dispense oral health care products, offer screenings for oral diseases, and provide appropriate referrals for dental treatment.¹¹⁻¹³ Subsequently, screenings for both diabetes and hypertension were added as primary health care services offered to senior center attendees.¹⁴⁻¹⁵

In an earlier report,¹⁵ we examined self-reported diabetes and self-reported hypertension as determinants of tooth loss among *ElderSmile* participants. Multivariable models (both binary and ordinal logistic regression) were consistent in that older age and Medicaid were important covariates when self-reported diabetes and self-reported hypertension were included, along with an interaction term between self-reported diabetes and self-reported hypertension. The aim of this study is to determine if the relationship between glycosylated hemoglobin (HbA1c) and number of teeth present in community-dwelling older adults is modified by dental insurance coverage status. To address this aim, we used a marginalized zero-inflated Poisson model that takes into account the extra zero counts for number of teeth present and lack of independence in the empirical data, while also allowing generalization of inference to the entire population under study.^{16–18}

Methods

Data for this study were obtained via intake interviews, clinical dental assessments, and measurement of HbA1c. Details of the *ElderSmile* clinical program and the primary care screening enhancements are provided elsewhere.^{11–15} With regard to the current study, patient intake information was obtained by questionnaire in English or Spanish, according to patient preferences. The sociodemographic information gathered included gender, race/ethnicity, and age. For the purposes of the analyses presented here, participants were categorized by race/ethnicity as Hispanic, non-Hispanic White, non-Hispanic Black, and Other. Age was categorized as younger than 65 years, 65–74 years, and 75 years or older.

Smoking status was characterized as never smoked, former smoker, or current smoker. *ElderSmile* participants in the former smoker and never smoked categories were determined by dividing the subset of older adults who reported that they do not currently smoke cigarettes or cigars into those who reported that they ever smoked cigarettes or cigars (former smokers), and those who reported that they did not ever smoke cigarettes or cigars (never smokers).

Patients were asked if they had dental insurance (yes, no) and if so, what type (Medicaid, private, and other), and the time since last dental visit (< 1 year, 1–3 years, and > 3 years). Dental insurance coverage status was categorized as none, Medicaid only, and any private/other.

A faculty dentist performed a screening assessment on older adults who agreed to participate. Participants were examined for the number teeth present. A total of 28 teeth were considered; third molars were excluded from the analyses.

Finally, glycemic status as assessed by HbA1c was measured by a point-of-care test using capillary (finger stick) blood via a DCA Vantage Analyzer.¹⁹ Cut-points for measured HbA1c were as follows: normal = HbA1c < 5.6%; pre-diabetes = HbA1c between 5.7 and 6.4%; and diabetes = HbA1c ≥ 6.5%.²⁰ For patients with previously diagnosed diabetes, an HbA1c of 7.0% or higher was considered as poor glycemic control, and an HbA1c of less than 7.0% was considered as acceptable glycemic control.

An unadjusted marginal zero-inflated Poisson regression model for glycemic status, dental insurance coverage status, and the interaction between them as the independent variables and number of teeth present as the dependent variable was first analyzed. The multivariable analyses focused on glycemic status (the main predictor variable) and number of teeth present (the outcome variable) under a marginal zero-inflated Poisson model, adjusting for other participant information, initially including age, gender, Hispanic ethnicity, smoking status, and time since last dental visit (these were the potential confounders deemed to be important in preliminary analyses). The moderating effect of dental insurance coverage status on these associations was evaluated by including interaction terms between HbA1c and dental insurance coverage status in the models.

The zero-inflated Poisson (ZIP) regression model is often employed in health research to examine the relationships between exposures of interest and a count outcome exhibiting many zeros, in excess of the amount expected under sampling from a Poisson distribution.^{16–18} The regression coefficients of the ZIP model have latent class interpretations, which correspond to a susceptible subpopulation at risk for the condition, with counts generated from a Poisson distribution, and a non-susceptible subpopulation that provides the extra or excess zeros. The ZIP model parameters, however, are not well suited for inference targeted at overall exposure effects, specifically, in quantifying the effect of an explanatory variable in the overall population. We thus used a marginalized zero-inflated Poisson (MZIP) regression model for independent responses to directly model the population mean count for number of teeth present. This model generates two sets of estimates: rate ratios (RR) for the count section and odds ratios (OR) for the zero-inflated section. See the Statistical Appendix (available from the authors upon request) for further details and applicable equations.

The Vuong closeness test makes probabilistic statements about two models.²¹ They may be nested, non-nested, or overlapping. The statistic tests the null hypothesis that the two models are equally close to the true data generating process, against the alternative that one model is closer.²¹ The Vuong test that is available in R compares the MZIP regression model with an ordinary Poisson regression model.

Missing values were imputed using a Bayesian statistical technique known as multiple imputation,²² which has been used previously in related oral health research.²³ The approach to multiple imputation employed in this study involved constructing $m = 10$ different datasets by estimating each missing observation m times, performing data analysis on each of the imputed datasets, and combining the results from the analysis of each dataset. The combined results, derived from the separate analyses of the 10 multiple-imputed datasets, were then used as a basis for statistical inference.

All statistical and graphical analyses were performed using SAS, version 9.4 (see https://www.sas.com/en_us/software/sas9.html) and R, version 3.1 (see <https://cran.r-project.org/bin/windows/base/old/3.1.0/>). Appropriate Columbia University Medical Center and New York University School of Medicine institutional review board, and Health Insurance Portability and Accountability Act safeguards were followed.

Results

The analyses presented here are based on a sample of 785 older adults who participated in the *ElderSmile* program from 2010 through 2013 and had information available on dental insurance coverage status (there were a total of 1,015 records available after multiple imputation for missing values). The responses for given variables were at times less than these numbers, as certain individuals decided not to participate in all components of the program, or elected not to respond to particular questions.

The characteristics of the *ElderSmile* program participants (overall and by dental insurance coverage status) are presented in Table 1.

Three of every five participants ($475/785 = 61\%$) reported having Medicaid coverage. More than three-quarters of the participants were women (78%), and fully two-thirds (67%) were of Hispanic ethnicity. There were meaningful differences by dental insurance coverage status ($p\text{-value} < .05$) for the following sociodemographic, health, and health care characteristics: gender, race/ethnicity, smoking status, last dental visit, and number of teeth present.

Figure 1 presents the number of teeth present by the number of *ElderSmile* program participants.

A large number of 0 values are present, representing edentulous participants.

When the number of teeth present is displayed graphically by glycemic status (normal/pre-diabetes versus diabetes) and stratified by dental insurance coverage status (none, Medicaid only, and private/other), several results merit comment (Figure 2).

First, among participants with glycemic status in the diabetes range, the median number of teeth present is about the same regardless of dental insurance coverage status (15–16 teeth). This is not true among participants without glycemic status in the diabetes range, where the median number of teeth present for those with Medicaid coverage only (nine teeth) is much lower than for those with no dental insurance (19 teeth) or any private/other dental insurance (18 teeth).

Second, the relationship between number of teeth present and glycemic status is in the expected direction for participants with no dental insurance and any private/other dental insurance, where the number of teeth present is less for participants with diabetes than for participants without diabetes. Nonetheless, for participants with Medicaid coverage only, the relationship is reversed: participants without diabetes have fewer teeth than participants with diabetes.

The relationship between glycemic status and number of teeth present was examined using both HbA1c as a continuous variable and glycemic status as a categorical variable [normal, pre-diabetes, diabetes (controlled), diabetes (uncontrolled)]. Similar results were found, so we present here only the HbA1c findings, since they are more straightforward to interpret (the categorical results are available from the authors upon request). Similarly, gender,

Hispanic ethnicity, age, smoking status, and time since last dental visit were initially included in the models as potential confounders, but age and time since last dental visit were the only two that were important in all of the models examined, so we elected to present the simpler models for ease of interpretation (the full model results are available from the authors upon request). For each MZIP regression model, the output is presented in two parts: (1) the count section provides the rate ratio, i.e., the ratio of expected counts, along with the corresponding 95% confidence intervals (C.I.); (2) the zero-inflation section provides the odds ratio, i.e., the ratio of the probability of having 0 which is not accounted for in the Poisson model, along with the corresponding 95% C.I.

Table 2 presents the results of the unadjusted MZIP regression model with HbA1c, dental insurance coverage (where none is the reference category), and the interaction between them as the independent variables and number of teeth present as the dependent variable.

Both Medicaid and its interaction with HbA1c are statistically significant in the count model.

Tables 3a and 3b present the results of the adjusted MZIP regression model with HbA1c, dental insurance coverage (where again none is the reference category), and the interaction between them, along with age and time since last dental visit as the independent variables and number of teeth present as the dependent variable. In the model presented in Table 3a, the interaction terms between HbA1c and dental insurance coverage are not included in the zero-inflated section of the model, even as they are present in the count section (explained in detail below).

For comparison purposes, Table 3b includes the interaction terms in both sections of the model, but the goodness of fit for the model presented in Table 3a is improved for the data at hand.

The count sections of Tables 3a and 3b are consistent, with age, HbA1c, Medicaid, last dental visit more than three years ago, and the interaction term between HbA1c and Medicaid all statistically significant. In the zero-inflated sections of the models, age and last dental visit one to three years ago were statistically significant in both, whereas Medicaid was only statistically significant in the model presented in Table 3a.

In Table 3b (but not in Table 3a), the two interaction terms in the zero-inflated section violate the goodness of fit performance of the model. This happens because as the number of variables increases, so too does the estimated variance for dental insurance coverage, and as a result the confidence intervals are wide for the terms Medicaid and Private/Other. In Table 3a, on the other hand, narrower confidence intervals are obtained for the dental insurance coverage terms and Medicaid is statistically significant in the zero-inflated section as well as in the count section of the model.

Finally, Table 4 presents the results of the same adjusted MZIP regression model as that presented in Table 3a after multiple imputation to account for missing values.²¹

Virtually all of the independent variables in the model presented in Table 4 were statistically significant, with the sole exception being Private/Other dental insurance in the zero-inflated section. The Vuong test statistic²¹ is significant ($p < .01$), indicating that the MZIP regression model is superior to the standard Poisson regression model.

Discussion

A novel finding from this study is that Medicaid coverage may be an important modifier of the observed relationship between glycemic status and number of teeth present. In other words, these data indicate that dental providers must consider access to quality care or lack of it in evaluating the relationship of glycemic status and tooth loss in their patients.

A potentially important consideration is the range of services provided by Medicaid dental plans. Adult dental services are not covered in most plans, which as mentioned previously differ by state.^{24,25} Even when adult dental insurance coverage is available (as it is in New York), it is not comprehensive. If a patient presents with advanced dental disease requiring comprehensive prosthodontic care, which is not covered by the New York Medicaid plan, extraction may be the selected option. Instead, the status of each tooth must be carefully evaluated, especially periodontally. Further, limited health literacy may lead Medicaid patients to choose extraction and denture fabrication over more expensive and time-consuming services intended to maintain teeth. Finally, patients with Medicaid are more economically disadvantaged and/or disabled than patients not on Medicaid, which places them at increased risk for poor oral and general health.

The participants in this study were seen at senior centers in northern Manhattan (New York, N.Y.). These centers serve ambulatory older adults, are focused on the needs of poor and racial/ethnic minority residents, and provide a range of activities and services.²⁶ Compared with older adults in New York City overall, attendees at senior centers tend to have both a higher prevalence of chronic conditions and a higher percentage of individuals who report being in poor or fair versus good or excellent general health.²⁷

Both pre-diabetes and diabetes are risk factors for increased severity of periodontitis and tooth loss.³ Recently, Hispanic people with uncontrolled diabetes were found to have a significantly increased likelihood of missing more than nine teeth and being edentulous than people with normal glycemic status.²⁸

The results obtained upon stratifying the study population by dental insurance coverage status point to the potential importance of Medicaid coverage as a modifying factor when assessing the relationship of glycemic status and number of teeth present. While Medicaid status is important in studies conducted in states with adult Medicaid dental insurance coverage such as New York, it may not be as important in studies conducted in states without adult Medicaid dental insurance coverage.²⁹

As expected, age was an important determinant of tooth loss in our study.^{30,31} Tooth loss is the result of a number of factors, including the cumulative effects of dental disease, reduced salivary flow,³² provider treatment preferences, and patient factors, including health literacy

and financial concerns. The increased prevalence of chronic conditions among older as compared with younger adults³³ may also contribute to the decision to retain or extract teeth.

Older adults with diabetes have fewer teeth than older adults without diabetes.³⁴ In our study, this relationship was found only for participants with no dental insurance coverage (likely as a result of retirement) or any private/other dental insurance. The New York State Medicaid program provides relatively robust adult dental insurance coverage compared with other U.S. states.³⁵ This program includes emergency dental care as well as preventive and restorative dentistry, but limited prosthodontic and endodontic treatment.³⁵ There are, however, major barriers to plan utilization. The number of dentists in New York who accept Medicaid is limited, and more complex treatment is not covered.³⁶ Individuals who have not received regular dental care often require advanced prosthodontic treatment. Since the New York State Medicaid program does not reimburse providers for advanced prosthodontic treatment, it appears that tooth extraction becomes the elected treatment approach.³⁷

In support of our findings, individuals in the New York State Medicaid program tend to have more missing teeth than filled teeth.³⁸ This could be due to the limited range of services that are covered, and the tendency to extract teeth rather than retain them when a necessary procedure is not reimbursed. When participants in our study reported Medicaid insurance coverage, we did not find the expected association between glycemic status and teeth present.

Patients with poorly controlled diabetes have more dental problems than patients with well-controlled diabetes.³⁴ This includes fewer teeth than healthy patients, which is especially pronounced for older adults.³⁹ Diabetes is the only systemic disease that is recognized as a risk factor for periodontitis.¹ The bidirectional relationship between diabetes and periodontal disease also suggests that a lack of access to dental care for patients with periodontal disease could lead to poor diabetes control.⁴⁰

There are a number of limitations to this study. All participants attended community centers in northern Manhattan and thus were ambulatory. Therefore, these findings are not necessarily generalizable to populations of older individuals who are homebound or long-term care residents. Further, participation in the *ElderSmile* program at senior centers in northern Manhattan is strictly voluntary, as was completion of the intake questionnaire and involvement in the clinical assessments. Older adults who agreed to participate in these activities may differ in important ways from those who declined to participate. Because of the time involved in the clinical dental examinations and especially the HbA1c testing before a second instrument was purchased, not all participants elected to wait to be screened for glycemic status and needed dental care. Thus, there were the largest percentages of missing values for HbA1c (33.79%) and number of teeth present (25.61%).

The disruption of the inverse relationship between glycemic status and teeth present in participants with Medicaid may be explained by the lack of comprehensive restorative and prosthetic insurance coverage in the New York State Medicaid program, with tooth extraction becoming the treatment of choice when moderately advanced dental disease is present. Other explanations for the disrupted relationship include: (1) individuals with

Medicaid had increased tooth loss before diabetes developed, as a result of decreased access to services, low health care literacy, and increased severity of periodontitis in pre-diabetes;³ and (2) there are other unknown modifiers of tooth loss in patients without diabetes who are Medicaid eligible. An example may be weight gain and elevated body mass index (BMI), which is a pro-inflammatory condition and places patients at increased risk of developing diabetes⁴¹ and periodontal disease.⁴²

These findings suggest the need to consider dental insurance coverage status, and in particular Medicaid, of U.S. adults as a determinant of tooth loss. Further, the increased tooth loss observed in individuals with Medicaid implies the need for discussions about the emphasis placed on health literacy and prevention in the Medicaid program. Tooth loss as a result of caries and periodontal disease occurs over years, even decades, and both diseases are largely preventable with a focus on the need for dental hygiene and conservative professional care. This message must be repeatedly emphasized to those at greatest risk for oral disease. With the expansion of Medicaid dental benefits to large numbers of children under the Affordable Care Act,⁴³ the importance of a prevention strategy is critical. This is a fundamental concept in the provision of dental services, and our findings emphasize the particular importance of prevention for underserved populations. These data may be used to argue for changes in how Medicaid dental programs reimburse providers. An emphasis on prevention, either through increased frequency of preventive services or based on achieving desired outcomes, should be a priority for policymakers and oral health care providers alike.

Future research by the investigators includes integrating community-based participatory research and implementation science approaches to translate evidence-based practices such as brushing with fluoride toothpaste to prevent dental caries into culturally tailored programs that are delivered by trusted community leaders in local settings.⁴⁴ In addition, research efforts to integrate oral health and primary care for medical conditions hold promise for intervening before the disease is severe, and reducing the morbidity and premature mortality from diabetes and other primary care sensitive conditions.^{45,46}

The findings that Medicaid modifies the established association of glycemic status with teeth present in older adults, and that fewer teeth present is associated with Medicaid insurance coverage in participants without diabetes are both important, because together they identify potentially meaningful determinants of tooth loss while emphasizing its complex nature. Medicaid coverage alone is not sufficient to reduce barriers to quality dental services for enrollees.⁴⁷

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Distribution of the number of teeth present among *ElderSmile* program participants (third molars excluded): New York, NY; 2010–2013.

Figure 2.

Number of teeth present (third molars excluded) by glycemic status (normal/pre-diabetes versus diabetes) stratified by dental insurance coverage status (none, Medicaid only, any private over). Boxplots with medians and interquartile ranges emphasized are presented since the number of teeth present is not a normal distribution.

Table 1. SOCIODEMOGRAPHIC, HEALTH AND HEALTH CARE CHARACTERISTICS OF PARTICIPANTS OVERALL AND BY DENTAL INSURANCE COVERAGE STATUS: ELDERSMILE PROGRAM, NEW YORK, NY, USA, 2010–2013 (N = 785)^a

Characteristic	Overall (n = 785) No. (%)	Medicaid Only (n = 475) No. (%)	None (n = 131) No. (%)	Any Private / Other (n = 179) No. (%)	p-value ^b
Gender (n = 770)					< .01
Men	167 (22)	119 (26)	21 (16)	27 (15)	
Women	603 (78)	346 (74)	108 (84)	149 (85)	
Race/ethnicity (n = 742)					< .01
Hispanic	498 (67)	331 (73)	72 (58)	95 (56)	
Non-Hispanic White	60 (8)	19 (4)	16 (13)	25 (15)	
Non-Hispanic Black	159 (22)	90 (20)	26 (21)	43 (25)	
Other	25 (3)	10 (2)	9 (7)	6 (4)	
Age group (n = 718)					.06
< 65 years	110 (15)	81 (18)	10 (8)	19 (12)	
65–74 years	306 (43)	180 (41)	53 (45)	73 (46)	
75 years	302 (42)	180 (41)	55 (47)	67 (42)	
Smoking status ^c (n = 555)					.02
Never smoked	322 (58)	213 (61)	54 (65)	55 (46)	
Former smoker	162 (29)	92 (26)	23 (28)	47 (39)	
Current smoker	71 (13)	47 (13)	6 (7)	18 (15)	
Last dental visit (n = 692)					< .01
< 1 year	365 (53)	237 (56)	47 (41)	81 (52)	
1–3 years	204 (29)	105 (25)	39 (34)	60 (38)	
> 3 years	123 (18)	80 (19)	28 (25)	15 (10)	
Diabetes status (n = 538)					.82
Normal (HbA1c < 5.7%)	197 (37)	119 (34)	31 (38)	47 (42)	
Pre-diabetes (HbA1c = 5.7–6.4%)	193 (36)	131 (38)	27 (33)	35 (32)	
Diabetes (HbA1c ≥ 6.5%)					
Controlled (HbA1c = 6.5%–<7%)	60 (11)	39 (11)	10 (13)	11 (10)	

Characteristic	Overall (n = 785)		Medicaid Only (n = 475)		None (n = 131)		Any Private / Other (n = 179)		p-value ^b
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
Uncontrolled (HbA1c ≥ 7%)	88	(16)	57	(17)	13	(16)	18	(16)	< .01
Number of teeth present (n = 601)									
0–9	137	(23)	102	(28)	14	(14)	21	(15)	
10–19	257	(43)	159	(44)	43	(42)	55	(40)	
20–28	207	(34)	101	(28)	45	(44)	61	(45)	

Notes

^a Sample sizes (hence denominators used to compare percentages) may vary across characteristics because of missing values.

^b p-values correspond to the testing of differences between participants by dental coverage status using a chi-squared (Fisher's exact) test.

^c ElderSmile participants in the former smoker and never smoked categories were determined by dividing the subset of older adults who reported that they do not currently smoke cigarettes or cigars into those who reported that they ever smoked cigarettes or cigars (former smokers), and those who reported that they did not ever smoke cigarettes or cigars (never smokers).

Table 2.

UNADJUSTED MARGINAL ZERO-INFLATED POISSON REGRESSION MODEL FOR GLYCOSYLATED HEMOGLOBIN (HBA1C), DENTAL INSURANCE COVERAGE STATUS, AND THE INTERACTION BETWEEN THEM AS THE INDEPENDENT VARIABLES AND NUMBER OF TEETH PRESENT AS THE DEPENDENT VARIABLE: ELDERSMILE PROGRAM, NEW YORK, NY, USA, 2010–2013

Independent Variables	Model	Rate Ratio	(95% Confidence Interval)
HbA1c		.978	(.932–1.026)
Medicaid		.558	(.394–0.790)**
Private/Other	Count	.916	(.618–1.358)
HbA1c X Medicaid		1.066	(1.010–1.126)*
HbA1c X Private/Other		1.016	(.956–1.081)

Independent Variables	Model	Odds Ratio	(95% Confidence Interval)
HbA1c		.619	(.234–1.637)
Medicaid		.413	(.001–151.5)
Private/Other	Zero-inflation	.151	(.000–79.87)
HbA1c X Medicaid		1.404	(.515–3.823)
HbA1c X Private/Other		1.536	(.534–4.420)

Notes

*
p= .05

**
p= .01

Table 3a.

ADJUSTED MARGINAL ZERO-INFLATED POISSON REGRESSION MODEL FOR GLYCOSYLATED HEMOGLOBIN (HBA1C), DENTAL INSURANCE COVERAGE STATUS, AND THE INTERACTION BETWEEN THEM, ALONG WITH AGE AND TIME SINCE LAST DENTAL VISIT AS THE INDEPENDENT VARIABLES AND NUMBER OF TEETH PRESENT AS THE DEPENDENT VARIABLE: ELDERSMILE PROGRAM, NEW YORK, NY, USA, 2010–2013

Independent Variables	Model	Rate Ratio	(95% Confidence Interval)
Age		.994	(.990–.997) ***
HbA1c		.929	(.877–.983) *
Medicaid		.357	(.238–.536) ***
Private/Other	Count	.749	(.448–1.252)
Dental visit 1–3 years		.939	(.877–1.006)
Dental visit > 3 years		.901	(.828–.980) *
HbA1c X Medicaid		1.138	(1.067–1.213) ***
HbA1c X Private/Other		1.052	(.968–1.143)

Independent Variables	Model	Odds Ratio	(95% Confidence Interval)
Age		1.056	(1.025–1.087) ***
HbA1c		.911	(.709–1.170)
Medicaid	Zero-inflation	3.676	(1.467–9.210) **
Private/Other		1.812	(.625–5.250)
Dental visit 1–3 years		2.039	(1.143–3.638) *
Dental visit > 3 years		1.089	(.536–2.215)

Notes

*
p = .05**
p = .01***
p = .001

Table 3b.

ADJUSTED MARGINAL ZERO-INFLATED POISSON REGRESSION MODEL FOR GLYCOSYLATED HEMOGLOBIN (HBA1C), DENTAL INSURANCE COVERAGE STATUS, AND THE INTERACTION BETWEEN THEM, ALONG WITH AGE AND TIME SINCE LAST DENTAL VISIT AS THE INDEPENDENT VARIABLES AND NUMBER OF TEETH PRESENT AS THE DEPENDENT VARIABLE: *ELDERSMILE* PROGRAM, NEW YORK, NY, USA, 2010–2013

Independent Variables	Model	Rate Ratio	(95% Confidence Interval)
Age		.994	(.990–.997) ***
HbA1c		.929	(.877–.983) *
Medicaid		.357	(.238–.536) ***
Private/Other	Count	.749	(.448–1.252)
Dental visit 1–3 years		.939	(.877–1.006)
Dental visit > 3 years		.901	(.828–.980) *
HbA1c X Medicaid		1.138	(1.067–1.213) ***
HbA1c X Private/Other		1.052	(.968–1.143)

Independent Variables	Model	Odds Ratio	(95% Confidence Interval)
Age		1.056	(1.025–1.088) ***
HbA1c		.666	(.228–1.947)
Medicaid		.461	(.001–330.2)
Private/Other	Zero-inflation	.380	(.000–717.0)
Dental visit 1–3 years		2.055	(1.151–3.667) *
Dental visit > 3 years		1.086	(.534–2.209)
HbA1c X Medicaid		1.416	(.468–4.283)
HbA1c X Private/Other		1.300	(.365–4.624)

Notes

*
p= .05

**
p= .01

***
p= .001

Table 4.

ADJUSTED MARGINAL ZERO-INFLATED POISSON REGRESSION MODEL FOR GLYCOSYLATED HEMOGLOBIN (HBA1C), DENTAL INSURANCE COVERAGE STATUS, AND THE INTERACTION BETWEEN THEM, ALONG WITH AGE AND TIME SINCE LAST DENTAL VISIT AS THE INDEPENDENT VARIABLES AND NUMBER OF TEETH PRESENT AS THE DEPENDENT VARIABLE AFTER APPLYING MULTIPLE IMPUTATION FOR MISSING VALUES^a: ELDERSMILE PROGRAM, NEW YORK, NY, USA, 2010–2013

Independent Variables	Model	Rate Ratio	(95% Confidence Interval)
Age		.993	(.993–.993) *
HbA1c		.936	(.934–.938) *
Medicaid		.412	(.371–.458) *
Private/Other	Count	.742	(.659–.836) *
Dental visit 1–3 years		.916	(.914–.919) *
Dental visit > 3 years		.878	(.873–.882) *
HbA1c X Medicaid		1.113	(1.110–1.116) *
HbA1c X Private/Other		1.053	(1.050–1.057) *

Independent Variables	Model	Odds Ratio	(95% Confidence Interval)
Age		1.058	(1.058–1.058) *
HbA1c		.902	(.869–.937) *
Medicaid	Zero-inflation	3.212	(2.185–4.722) *
Private/Other		1.382	(.836–2.286)
Dental visit 1–3 years		2.140	(1.773–2.583) *
Dental visit > 3 years		1.343	(1.072–1.683) *

Notes

^a The percent of missing values for the variables in the model are as follows: age 3.94%; HbA1c 33.79%; dental coverage 22.66%; time since last dental visit 14.38%; number of teeth present 25.61%.

*
p = .05

**
p = .01

***
p = .001