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## Trajectories of Depressive Symptoms and Oral Health Outcomes in a Community Sample of Older Adults

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### Abstract

**Objective**—Adverse outcomes associated with chronic depressive symptoms are of clinical importance. The objective was to identify subgroups of older adults based on their trajectories of depressive symptoms over a ten-year period, and determine if these subgroups predicted oral health outcomes.

**Methods**—Secondary analysis of data from the Health and Retirement Survey. The sample was 944 adults age 65+ who participated in the oral health module in 2008. Depressive symptoms were measured with a modified version of the Center for Epidemiologic Studies–Depression (CES-D) scale. Latent class trajectory analysis was used to identify distinct subgroups of elders based on their CES-D scores from 1998–2008. Group membership was used to predict self-rated oral health, overall mouth condition (problems with bleeding gums, gum sensitivity, and food avoidance), and edentulism in 2008.

**Results**—Three distinct subgroups were identified using zero inflated Poisson regression models: (a) minimal depressive symptoms over the study period (43%), (b) low but generally stable level of depressive symptoms (41%), and (c) moderate symptoms and higher CES-D scores than the other groups over the 10 years (16%). Controlling for demographic and health variables and edentulism status, having a trajectory of moderate symptoms was associated with poorer mouth condition ( $p < 0.0001$ ) and poorer self-rated oral health ( $p = 0.0003$ ) compared to those with minimal symptoms. Having low levels of depressive symptoms was not significantly associated

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with these two outcomes. Group membership was not significantly associated with the probability of edentulism.

**Conclusions**—Chronic moderate depressive symptoms are associated with poorer oral health in older adults.

### Keywords

depressive symptoms; oral health; edentulism; latent class trajectory analysis

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## Introduction

Clinicians treating older adults are aware of the adverse consequences of depressive symptoms. Late life depressive symptoms are linked to functional decline, cognitive decline, increased mortality, poorer cardiovascular health, and decreased social functioning (Blazer, 2003). Treating the symptoms in some cases can reverse the outcomes, or at least stabilize decline, yet many older adults experience a chronic course of depressive symptoms.

Little is known about oral health outcomes associated with chronic depressive symptoms. Older adults with depressive symptoms may be less likely to make self-care, including oral hygiene and preventive dental care, a priority. Late life depression and depressive symptoms may be associated with poor nutrition, diminished salivary flow, distorted taste, a higher oral lactobacillus count, dental decay, advanced periodontal disease, and oral discomfort (D'Mello, 2003; Friedlander and Norman, 2002). Poor oral health has its own adverse consequences. Poor mouth conditions, such as bleeding gums, for example, may lead to incident cardiovascular disease (Buhlin *et al.*, 2003). Problems with oral pain and discomfort and tooth loss may lead to problems with nutrition (Nowjack-Raymer and Sheiham, 2003; Poisson *et al.*, 2014) and subsequent frailty (Fried *et al.*, 2001), which can be associated with depression (Blazer, 2003).

Most studies examining the association between depressive symptoms and oral health have been cross-sectional, and among younger and middle-aged adults. Depressive symptoms have been linked to poorer self-rated oral health (Finlayson *et al.*, 2010) and oral health related quality of life (de Andrade *et al.*, 2012; Hassel *et al.*, 2011). In the National Survey of American Life, 12.8% of the adults who had fair or poor self-rated oral health had experienced major depression in the previous 12 months compared to 4.4% of those with good, very good, or excellent self-rated oral health. Controlling for demographic variables, other psychosocial stressors, and psychosocial resources, adults with major depression were twice as likely to have fair or poor self-rated oral health (Finlayson *et al.*, 2010). Adults with current depression are more likely to have tooth loss (Okoro *et al.*, 2012). Numerous cross-sectional studies have found an association between depressive symptoms and increased periodontal disease (Ng and Leung, 2006; Saletu *et al.*, 2005), although others have not found an association (Solis *et al.*, 2004).

There have been fewer studies from older populations. Among older adults, individuals with more depressive symptoms have reported oral discomfort (dry mouth, mouth pain, mouth swelling) and worse oral health-related quality of life (Kressin *et al.*, 2002; Saintrain *et al.*,

2013). While associations between depressive symptoms and periodontitis among younger adults are generally significant, in a sample of 701 older adults, depressive symptoms were associated with heart attack, stroke, high blood pressure, cardiovascular disease, chronic pain, osteoarthritis and osteoporosis but not periodontitis. Persons with depressive symptoms, however, had a higher self-reported risk score for future tooth loss (Persson *et al.*, 2003). There is very limited understanding of how chronic depressive symptoms are related to later oral health outcomes in the older population.

Over time, the presence or absence of depressive symptoms can be dynamic. Trajectories of depressive symptoms can reveal much information about the course of clinically significant symptoms. That is, trajectories can be superior to cross-sectional measures of depression which may reflect transitory affective states due to life events. Distinct courses of depressive symptoms in the general community-dwelling older populations have been identified (Liang *et al.*, 2011). It is not known whether these distinct population subgroups based on their trajectories of depressive symptoms have different oral health outcomes.

The purpose of these analyses was 1) to identify distinct classes of older adults based on their trajectories of depressive symptom scores over ten years; and 2) to examine trajectory class membership as a predictor of oral health at the end of the study period. We hypothesized that multiple trajectories of depressive symptoms exist, which differ in their levels and rates of change. In addition, we hypothesized that these trajectories of depressive symptoms would be associated with oral health, mouth condition, and dentate status. For example, that a trajectory of a higher level of chronic depressive symptoms would be associated with poorer oral health (i.e., self-rated oral health, mouth condition, and dentate status).

## Methods

### Study Sample

The data were taken from six waves (1998–2008) of the Health and Retirement Survey (HRS) conducted in the U.S. using a national representative probability sample of older adults, with interviews every two years. Detailed information about the HRS can be found on its website (<http://hrsonline.isr.umich.edu>). An oral health module was included in the 2008 survey and administered to a subsample of the HRS participants. A total of 944 adults who completed the oral health questions and were age 65 or older in 2008 comprised the study sample for the analyses presented here. Depressive symptoms of interest were those measured over the ten-year period preceding the oral health module.

### Study Variables

*Depressive symptoms* were measured using a modified version of the Center for Epidemiologic Studies – Depression (CES-D) scale (Radloff, 1977). Eight CES-D symptoms were included in the HRS: felt depressed, felt everything was an effort, sleep was restless, felt happy, felt lonely, enjoyed life, felt sad, and could not get going. Each symptom was coded 1 if present much of the time in the previous week and 0 if not. The symptoms

were summed with items in the positive direction reverse coded for a possible range of 0–8. The modified CES-D scores used were those in 1998, 2000, 2002, 2004, 2006, and 2008

*Oral health* was measured in three ways: *Self-rated oral health* asked respondents to describe the condition of their mouth and teeth using the categories of poor, fair, good or very good. The possible range of responses was 1–4, with higher scores reflecting better self-reported oral health. A *composite score* measuring problems with oral health was determined by summing the responses to three questions. Respondents were asked how often in the past year 1) they had avoided particular foods because of problems with their teeth, mouth, or dentures; 2) their gums had been sensitive to hot, cold, or sweets; and 3) they had their gums bleed when they brushed their teeth. The range of responses for the composite score was 3 to 15, with higher scores reflecting less often (better oral health). *Edentulism* was measured by self-report. Respondents were first asked if they had lost more than two natural permanent teeth (Respondents who answered no were coded as dentate). Respondents who answered yes to losing more than two permanent teeth were then asked if they had lost all teeth from their upper jaw and lower jaw. Respondents who had lost all teeth in both the upper and lower jaw were coded as edentulous. Responses were coded 1=No teeth and 0=one or more teeth.

Covariates known to be associated with depression and potentially oral health (Hybels *et al.*, 2001) were used at their 2008 value at the time of the oral health module. *Demographic variables* included age (range 65–100), sex, race (coded as White Y=1/N=0, Black Y=1/N=0, and Other Y=1/N=0), Hispanic ethnicity coded as Y=1/N=0, years of education (range 0–17), and annual household income in thousands (range 0 to 818). *Health variables* included the number of *functional difficulties* (range 0–12) measured as difficulties with walking, dressing, bathing, eating, getting in/out of bed, using the toilet, reading a map, using the telephone, handling money, taking medication, shopping, and preparing meals. Responses were coded as 0=no difficulty and 1=some difficulty or unable to do. *Self-rated health* was assessed by asking respondents to rate their health as excellent, very good, good, fair, or poor. Responses were coded from 1 to 5 with higher scores indicating poorer self-rated health. The total number of *health conditions* was measured by asking about the presence of seven chronic conditions: high blood pressure, diabetes, cancer, heart disease, stroke, lung disease, and arthritis. The number of conditions was summed, for a possible range of 0 to 7. Cognition was measured using a brief cognitive screening measure that assessed immediate and delayed recall, serial 7's, backwards count, orientation to time, object naming, and naming of the president and vice president. Scores could range from 0 to 35, with higher scores indicating stronger cognitive functioning.

### Statistical Analysis

We first identified distinct subgroups of participants based on their trajectories of CES-D scores over the ten-year period using group-based semi-parametric mixture models. While the range of CES-D scores was 0–8, there were a disproportionate number of zero scores, so we estimated zero inflated Poisson regression (ZIP) models. The trajectory groups were estimated from the CES-D scores alone with time as the only independent variable, with no covariates added that could influence class membership. We first tested a single trajectory

model, allowing for both quadratic and cubic terms to model the function of time in the Poisson distribution. We removed non-significant higher order terms, and determined our best fitting single trajectory model. We then estimated the best fitting model with two, three, and then four trajectories following the same process. The models were compared using Bayesian Information Criteria (BIC) statistics and posterior probabilities.

In our second step we examined the association between trajectory class membership from our best fitting model (as noted below this model had three trajectory classes) and the three measures of oral health, controlling for age, race, ethnicity, sex, years of education, income, health conditions, functional difficulties, self-reported physical health, and cognition. In the models examining the association between trajectory group and both the composite score reflecting mouth condition as well as self-rated oral health, we also controlled for dentate status. Variables were entered in a hierarchical manner. Model 1 included depression group only. Demographic variables were added in Model 2, health variables were added in Model 3, and dentate status was added in Model 4. To minimize the number of participants lost due to missing data, we imputed values for the oral health measures, CES-D score, and the covariates as necessary using three imputations. We adopted an inclusive analysis strategy that included a number of auxiliary variables in addition to the predictors in our models in imputing missing values (Enders, 2010; Schafer, 1997).

We then averaged the regression coefficients and adjusted the standard errors based on three imputed data files (Rubin, 1987). All analyses were conducted using SAS Version 9.3 (2011). The latent class trajectories were estimated using SAS Proc Traj (Jones and Nagin, 2007).

## Results

The characteristics of the sample are shown in Table 1. Our sample was predominantly female, non-Hispanic, and white, with a mean age of 75 years. The median income was approximately \$34,000. On average, the sample was healthy, with few functional limitations and good cognitive functioning. Oral health variables showed the sample had fair to good oral health. About one-fifth were edentulous.

A model with three trajectory classes fit the data best. The mean trajectories for the classes are shown in Figure 1. A total of 43% of the sample was in the group with minimal depressive symptoms (Group 1). This group had lower CES-D scores in 1998 compared to the other two groups, saw a decrease in CES-D score, and then remained stable with minimal symptoms over the ten-year period. A total of 41% of the sample was in the group with low depressive symptoms (Group 2), who on average saw a slight decrease in CES-D score after 1998 and then had depressive symptoms at a low level over the ten years. Sixteen percent of the sample was in a group who had moderate symptom levels throughout the survey period (Group 3). Within this class, the CES-D score did not significantly change over time. Those participants in the class with moderate depressive symptoms had scores around a score of 4 over the ten-year period. The HRS documentation shows that a score of 4 or more on the modified CES-D scale is comparable to a score of 16 or greater on the

traditional CES-D scale, the cut-point suggested as indicating 'clinically significant depressive symptoms' (Survey Research Center, 2000).

The results of the three trajectory classes estimated by the ZIP model are shown in Table 2. The parameter estimates represent the effect on the logged count of depressive symptoms from which we can derive the predicted count. The predicted CES-D score at baseline for those with minimal depressive symptoms (Group 1) would be 0.48, while the predicted scores for those with low-level depressive symptoms and those with moderate depressive symptoms (Groups 2 and 3) would be 1.91 and 4.22 respectively. The effect of time for those with minimal and low level symptoms (Groups 1 and 2) was significant and nonlinear – decreasing and then slightly increasing. The effect of time was linear and slightly increasing for those with moderate depressive symptoms (Group 3). The nonsignificant higher order term for time was removed for this group. In the second part of the model, the coefficients estimate the likelihood of a CES-D score of zero across all classes beyond that predicted by the count model. Higher order terms were not significant.

While the linear coefficient for the group with moderate symptoms (Group 3) shown in Table 2 appears inconsistent with Figure 1 (that is, the predicted score change is linear but the figure shows an increase then leveling off), this reflects the fact that the Poisson model which is linear in the logged counts is, by definition, nonlinear in the counts. The posterior probabilities for the three groups showed a good separation of classes. For the 411 persons assigned to the group with minimal symptoms (Class 1), the mean posterior probability for that class was 0.93 (SD=0.11; range 0.51 to 1.00). For the 389 persons assigned to the group with low levels of symptoms (Class 2), the mean posterior probability was 0.89 (SD=0.14; range 0.50 to 1.00). For the 144 persons assigned to the group with moderate symptoms (Class 3), the mean posterior probability was 0.92 (SD=0.14; range 0.54 to 1.00).

In Table 3 we show the results of the trajectory classes predicting mouth condition using linear regression. Model 1(M1) is uncontrolled, and shows both low ( $p=0.0075$ ) and moderate ( $p<0.0001$ ) depressive symptoms are significantly associated with mouth condition. For those with low symptom scores, there was a 0.43 decrease in the mouth condition composite score, while for those with moderate symptoms there was a 1.75 decrease in score relative to those with minimal symptoms. These associations remained significant when age, sex, race, ethnicity, education, and income were controlled (M2). When health conditions, functional difficulties, self-reported physical health, and cognition were controlled (M3), having low symptoms was not associated with mouth condition. Being in the group with moderate symptoms, however, was significant and remained so after dentate status was also controlled (M4). As shown in Model 4, those with moderate symptoms had a composite score 1.04 units lower than those with minimal symptoms. Being Hispanic and having more health conditions and functional limitations were also associated with poorer mouth condition. Being older and having more years of education were associated with fewer problems with the mouth and teeth. Those who were edentulous had fewer problems with the mouth and teeth.

Table 4 shows a similar pattern for self-rated oral health. Having low ( $p=0.0003$ ) or moderate ( $p<0.0001$ ) depressive symptoms was associated with poorer self-rated oral health

in uncontrolled analyses (M1), and when controlling for demographic variables (M2). When health variables were added to the model (M3), only the group with moderate symptoms was significantly associated with self-rated oral health. Those with moderate symptoms had a 0.34 unit decrease in self-reported oral health ( $p=0.0004$ ). When dentate status was added to the model (M4), having moderate symptoms was still significantly associated with poorer self-perceived oral health ( $p=0.0003$ ). Being Hispanic, having more functional limitations, and reporting poorer self-rated physical health were associated with poorer self-rated oral health. Being female, having more years of education and being dentate were associated with higher self-reported oral health.

Table 5 shows the relationship between the trajectory groups and the probability of being edentulous. Neither having low ( $p=0.5290$ ) nor moderate ( $p=0.7985$ ) depressive symptoms was associated with dentate status in controlled analyses. Having more years of education, and higher income was associated with a lower probability of being edentulous, while having more health conditions was associated with a higher probability.

While our ten-year trajectories of depressive symptoms predicted self-rated oral health and mouth condition in 2008, we noted that the trajectories were relatively flat. We estimated separate models adjusting for CES-D score in 2008 as well as trajectory class. Those with chronic moderate depressive symptoms (Group 3) had significantly poorer mouth condition after adjusting for current CES-D score and demographic and health covariates. Those with moderate symptoms also had poorer self-rated oral health controlling for current CES-D score, but the associations were due in part to the demographic and health variables measured in 2008. These findings suggest the trajectory classes, although relatively flat, provide information beyond that due to a cross-sectional measure of depressive symptoms.

## Discussion

We report the longitudinal association between depressive symptoms and oral health among older adults. We identified three distinct subgroups of older adults based on their counts of depressive symptoms over ten years. Our best fitting model, among those age 65+ who had remained in the sample for ten years prior to the oral health module, replicated earlier findings of heterogeneity among community-dwelling elders with respect to the experience of depressive symptoms over time, but had fewer trajectory classes than observed among those age 50+ who were in at least one wave of the HRS (Liang *et al.*, 2011).

While it is unlikely that many of these elders with chronic depressive symptoms met criteria for major depression, they may have met criteria for subthreshold or minor depression. It is known that subthreshold levels can be similar to more symptomatic depression in their associations with demographic, social and physical health variables (Hybels *et al.*, 2001). Depressive symptoms at a subthreshold level appear to have oral health consequences as well. We also note that while these classes differentiate primarily on severity (number of symptoms), the slopes indicated that those with lower CES-D scores at baseline actually saw a slight decrease in CES-D score (the nonlinear terms for time were significant) and had fewer symptoms over time, while those with higher CES-D scores at baseline essentially remained at a moderate level (the linear term was not significant). Identifying these distinct

patterns which reflect initial level and rates of change is one advantage of trajectory models over a single measure of CES-D score.

Clinicians treating older adults are justifiably concerned with adverse consequences associated with late life depressive symptoms. Oral health outcomes have received little attention in this older population, yet poor oral health can be associated with decreased psychological well-being as well as poorer physical health (de Andrade *et al.*, 2012; Hassel *et al.*, 2011). Being in a group with moderate CES-D scores over time was associated with both poorer mouth condition and poorer self-rated oral health. Being in a group with low depressive symptomatology, however, was not associated with poorer oral health when health variables were controlled. We did not observe a longitudinal association between depressive symptoms and the probability of edentulism, yet tooth loss is the result of poor oral health. Edentulism may be less time sensitive than self-reported oral health and mouth conditions. It is also possible that risk factors for edentulism occur prior to late life or that a longer period of follow-up would be necessary to observe an association.

These findings suggest chronic levels of clinically significant depressive symptoms are associated with poor oral health outcomes. These findings are clinically important for all those treating older adults because poor oral health can also lead to adverse outcomes. Depressive symptoms may affect oral health through a number of biological pathways. For example, depression may contribute to disease (in this case poor oral health) through immune dysregulation. Depression can stimulate the production of pro-inflammatory cytokines that can influence conditions such as periodontal disease (Kiecolt-Glaser and Glaser, 2002). Use of some antidepressants is linked with hyposalivation which can lead to poor oral health conditions and diseases including mouth dryness, a burning sensation, periodontal disease, progressive dental caries, and oral functioning difficulties (Peeters *et al.*, 1998). Non-biological pathways may include differences in dental hygiene practices and dental services use. For example, in a sample of younger adults, depressive symptoms were associated with lower tooth brushing frequency and lower frequency of dental visits (Knuuttila *et al.*, 2006). In another study, adults with current depression were less likely to use dental services in the past year than those without the disorder (Okoro *et al.*, 2012).

Our study has limitations. Depressive symptoms may affect the reporting of oral health. For example, in a cross-sectional study of older adults in Brazil, negative self-perception of oral health was associated with depressive symptoms, but not poor actual oral health (Mesas *et al.*, 2008). While we examined the trajectories of depressive symptoms over the ten-year period prior to the oral health module, it is possible some problems with mouth conditions and tooth loss preceded the collection of the depressive symptom information. Our sample included only those HRS respondents who participated in the oral health module in 2008. We do not have oral health measures from other waves. The effect between depressive symptoms and oral health may be mediated through measured variables such as physical health and functioning as well as through unmeasured latent variables such as poor nutrition and poor self-care. If mediation is present, our results would have underestimated the effect of depression group in these analyses. Depressive symptom trajectories have been shown to be affected by both mortality and attrition (Liang *et al.*, 2011). Information on antidepressant use or other treatment was not available in the HRS. Finally, depressive symptoms were



measured using a modified version of the CES-D, and it is not known how these relationships may differ in the presence of late life DSM major depression.

The strengths of the study, however, outweigh any limitations. The HRS is a large representative sample of community-dwelling older adults residing in the U.S. followed biannually over time. The availability of multiple measures of depressive symptoms allowed us to plot patterns of depressive symptoms over ten years prior to the oral health assessment in 2008. Latent class trajectory analysis allowed the identification of distinct subgroups based on their trajectories rather than assuming one trajectory of depressive symptoms with random variation around the mean over time. The large sample provided an acceptable number of persons in each trajectory class. While the trajectories were estimated using CES-D score alone, these trajectories were derived from latent variables. That is, the trajectories were derived from unmeasured variables as well as CES-D score and reflect underlying changes in variables such as health and cognition and depression treatment. Previous research has shown that there is moderate agreement between the trajectories derived using CES-D score alone and trajectories derived including time-varying covariates as well (Liang *et al.*, 2011). Finally, the analyses focused on older adults, a population subgroup at higher risk for poorer oral health.

## Conclusion

Chronic depressive symptoms can lead to poor oral health outcomes in older adults. Clinicians treating older adults with moderate levels of depressive symptoms may want to discuss with patients the need for healthy behavior including good oral health care.

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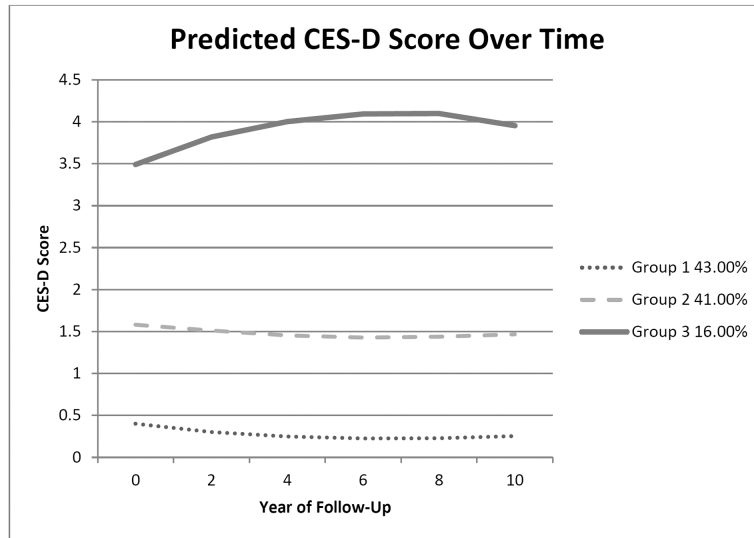
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### Key Points

1. Chronic moderate levels of depressive symptoms among older adults are associated with poorer self-rated oral health and overall mouth condition including problems with bleeding gums, gum sensitivity, and food avoidance.
2. Clinicians treating older adults with moderate levels of depressive symptoms may want to discuss with patients the need for healthy behavior including good oral health care.



**Figure 1.** Predicted values of CES-D score by trajectory class over 10 years (n=944)

**Table 1**

## Characteristics of the sample in 2008 (n=944)

<b>Sample Characteristic</b>	
<i>Dental Variables</i>	
No. Edentulous (%)	204 (21.6%)
Mean Self-Rated Oral Health (sd)	2.9 (1.1)
Mean Score for Mouth Condition (sd)	12.9 (2.1)
<i>Demographic Variables</i>	
No. Female (%)	549 (58.2%)
No. White (%)	799 (84.6%)
No. Black (%)	111 (11.8%)
No. Other Race (%)	34 (3.6%)
No. Hispanic (%)	74 (7.8%)
Mean age (sd)	75.0 (7.2)
Mean years of education (sd)	12.4 (3.1)
Mean income in thousands (sd)	55.1 (76.2)
<i>Health Variables</i>	
Mean number of functional limitations (sd)	0.9 (1.8)
Mean number of health conditions (sd)	2.3 (1.4)
Mean total cognition score (sd)	21.8 (5.3)
Mean CES-D Score (sd)	1.3 (1.9)

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**Table 2**

Change in CES-D scores over time predicted by trajectory groups estimated from a zero inflated Poisson regression model with three trajectory classes of depressive symptoms (n=944)

Group	Parameter	Estimate	Exp (Estimate)	Standard Error	p-value
Parameter Estimates for Count Portion					
1	Intercept	-0.726	0.48	0.115	<0.0001
	Time	-0.208	0.81	0.054	0.0001
	Time <sup>2</sup>	0.016	1.02	0.005	0.0025
2	Intercept	0.648	1.91	0.059	<0.0001
	Time	-0.068	0.93	0.025	0.0055
	Time <sup>2</sup>	0.006	1.01	0.002	0.0131
3	Intercept	1.440	4.22	0.037	<0.0001
	Time	0.010	1.01	0.005	0.0611
Zero Inflation Parameter Estimates					
	Intercept	-1.564	0.21	0.171	<0.0001
	Time	-0.302	0.74	0.101	0.0029
	Time <sup>2</sup>	0.029	1.03	0.010	0.0034

Table 3

Ten year trajectory groups of depressive symptoms predicting mouth condition using linear regression analyses (n=944)

Parameter	M1 Estimate	Std Error	p-value	M2 Estimate	Std Error	p-value	M3 Estimate	Std Error	p-value	M4 Estimate	Std Error	p-value
Intercept	13.3312	0.1053	<0.0001	12.6319	0.8111	<0.0001	11.7700	0.9761	<0.0001	11.5032	0.9752	<0.0001
Depression Group 2	-0.4286	0.1592	0.0075	-0.3292	0.1648	0.0467	-0.1464	0.1689	0.3868	-0.1609	0.1680	0.3390
Depression Group 3	-1.7544	0.2015	<0.0001	-1.4838	0.2124	<0.0001	-1.0225	0.2233	<0.0001	-1.0374	0.2213	<0.0001
Age in 2008				0.0019	0.0095	0.8445	0.0233	0.0104	0.0258	0.0225	0.0103	0.0298
Female (1=yes, 0=no)				-0.1878	0.1382	0.1752	-0.2180	0.1372	0.1132	-0.2298	0.1366	0.0936
Black (1=yes, 0=no)				-0.2838	0.2137	0.1852	-0.1434	0.2177	0.5106	-0.1309	0.2177	0.5479
Hispanic (1=yes, 0=no)				-0.7555	0.2773	0.0068	-0.7503	0.2742	0.0066	-0.7321	0.2729	0.0077
Other Race (1=yes, 0=no)				0.1904	0.3762	0.6131	0.2349	0.3707	0.5268	0.1616	0.3696	0.6623
Years of Education (0-17)				0.0556	0.0242	0.0224	0.0390	0.0252	0.1233	0.0539	0.0255	0.0357
Income in 2008 (1000s)				-0.0003	0.0009	0.7683	-0.0008	0.0009	0.3973	-0.0006	0.0009	0.5315
Total No. of Health Conditions in 2008							-0.1792	0.0521	0.0007	-0.1956	0.0521	0.0002
Functional Difficulties in 2008 (high=more difficulties)							-0.2190	0.0428	<0.0001	-0.2259	0.0426	<0.0001
Self-Reported Physical Health (higher=poorer)							-0.0209	0.0744	0.7792	-0.0197	0.0740	0.7903
Total Cognition Score in 2008							0.0003	0.0157	0.9864	0.0033	0.0156	0.8344
Edentulous (1=yes, 0=no)										0.5517	0.1684	0.0012

**Table 4**  
 Ten year trajectory groups of depressive symptoms predicting self-rated oral health using linear regression analyses (n=944)

Parameter	M1 Estimate	Std Error	p-value	M2 Estimate	Std Error	p-value	M3 Estimate	Std Error	p-value	M4 Estimate	Std Error	p-value
Intercept	3.1518	0.0435	<0.0001	2.8973	0.3368	<0.0001	3.2317	0.4063	<0.0001	3.0739	0.4038	<0.0001
Depression Group 2	-0.2338	0.0636	0.0003	-0.1806	0.0638	0.0049	-0.0815	0.0649	0.2103	-0.0891	0.0642	0.1664
Depression Group 3	-0.6773	0.0862	<0.0001	-0.5214	0.0887	<0.0001	-0.3329	0.0936	0.0004	-0.3404	0.0934	0.0003
Age in 2008				-0.0031	0.0039	0.4380	0.0005	0.0043	0.9135	0.0001	0.0043	0.9831
Female (1=yes, 0=no)				0.1522	0.0574	0.0085	0.1262	0.0571	0.0279	0.1187	0.0566	0.0368
Black (1=yes, 0=no)				-0.1523	0.0887	0.0871	-0.0972	0.0904	0.2831	-0.0935	0.0898	0.2986
Hispanic (1=yes, 0=no)				-0.5543	0.1152	<0.0001	-0.4971	0.1141	<0.0001	-0.4870	0.1130	<0.0001
Other Race (1=yes, 0=no)				-0.0489	0.1563	0.7545	-0.0610	0.1543	0.6927	-0.1036	0.1530	0.4990
Years of Education (0-17)				0.0313	0.0100	0.0019	0.0267	0.0105	0.0113	0.0353	0.0105	0.0009
Income in 2008 (1000s)				0.0004	0.0004	0.2621	0.0002	0.0004	0.6174	0.0003	0.0004	0.4343
Total No. of Health Conditions in 2008							0.0067	0.0219	0.7588	-0.0029	0.0217	0.8955
Functional Difficulties in 2008 (high=more difficulties)							-0.0386	0.0176	0.0294	-0.0427	0.0175	0.0153
Self-Reported Physical Health (higher=poorer)							-0.1640	0.0310	<0.0001	-0.1631	0.0307	<0.0001
Total Cognition Score in 2008							-0.0045	0.0065	0.4935	-0.0028	0.0065	0.6691
Edentulous (1=yes, 0=no)										0.3190	0.0695	<0.0001



**Table 5**  
Ten year trajectory groups of depressive symptoms predicting edentulism using logistic regression analyses (n=943)

Parameter	M1 Estimate	Std Error	p-value	Odds Ratio	M2 Estimate	Std Error	p-value	Odds Ratio	M3 Estimate	Std Error	p-value	Odds ratio
Intercept	-1.7179	0.1422	<0.0001		-0.5686	1.0009	0.5704		0.4199	1.2438	0.7359	
Depression Group 2	0.5848	0.1856	0.0018	1.80	0.2563	0.2007	0.2026	1.29	0.1318	0.2091	0.5290	1.14
Depression Group 3	0.9893	0.2444	0.0001	2.69	0.3615	0.2672	0.1771	1.44	0.0767	0.3002	0.7985	1.08
Age in 2008					0.0187	0.0116	0.1073	1.02	0.0053	0.0130	0.6849	1.01
Female (1=yes, 0=no)					0.0552	0.1805	0.7598	1.06	0.1184	0.1846	0.5217	1.13
Black (1=yes, 0=no)					0.0351	0.2535	0.8901	1.04	-0.1148	0.2663	0.6667	0.89
Hispanic (1=yes, 0=no)					-0.3071	0.3239	0.3439	0.74	-0.2765	0.3302	0.4031	0.76
Other Race (1=yes, 0=no)					0.7345	0.4125	0.0759	2.09	0.6385	0.4231	0.1323	1.89
Years of Education (0-17)					-0.1635	0.0312	<0.0001	0.85	-0.1478	0.0334	<0.0001	0.86
Income in 2008 (1000s)					-0.0098	0.0031	0.0019	0.99	-0.0088	0.0031	0.0047	0.99
Total No. of Health Conditions in 2008									0.1993	0.0657	0.0026	1.22
Functional Difficulties in 2008 (high=more difficulties)									0.0500	0.0489	0.3081	1.05
Self-Reported Physical Health (higher=poorer)									-0.0122	0.0938	0.8969	0.99
Total Cognition Score in 2008									-0.0297	0.0198	0.1359	0.97