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Do Socioeconomic Conditions Explain Ethnic Inequalities in Tooth Loss among US Adults?

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Objective: To assess whether there are ethnic differences in tooth loss among adult Americans aged <40 years and whether socioeconomic position attenuates these differences if they exist.

Methods: Data were from the 2014 Behavioral Risk Factor Surveillance System, a health-related telephone cross-sectional survey of a nationally representative sample of US adults. Tooth loss (one tooth or more) was used as the outcome variable. Ethnicity was the main explanatory variable. Family income, education and health insurance were also used in the analysis. Logistic regression models for tooth loss were constructed adjusting for demographic (age, sex, and ethnicity), socioeconomic indicators (income and education), health insurance, dental visits, smoking and diabetes.

Results: A total of 76,273 participants were included in the analysis. The prevalence of tooth loss was highest among Blacks (33.7%). Hispanics and other ethnic groups had a higher prevalence of tooth loss than Whites, 29.1% (95%CI: 27.7-30.6), 22.0% (95%CI: 20.3-23.8), and 20.8% (95%CI: 20.2-21.4), respectively. Blacks had odds ratios (OR) 1.98 (95%CI: 1.81-2.16) for tooth loss compared with Whites. After adjusting for socioeconomic positions (SEP), the relationship attenuated but remained significant with OR 1.71 (95%CI: 1.55-1.90).

Conclusions: Despite recent changes in the health care system in the United States, ethnic inequalities in tooth loss still exist. Income and education partially explained ethnic differences in tooth loss among Americans aged <40 years. *Ethn Dis*. 2018;28(3):201-206; doi:10.18865/ed.28.3.201

Introduction

There is extensive evidence on ethnic inequalities in oral health in the United States.[1] Repeated studies have shown that African and Hispanic Americans have higher rates of untreated caries, higher levels of periodontal diseases and more tooth loss than Whites.[2,3] It has been suggested that these ethnic inequalities are related to several factors specific to ethnic minorities. These include behavioral factors such as poor oral hygiene, smoking and poor diet.[4] Others have also argued that ethnic minorities are genetically more prone to diseases and to adopting unhealthy behaviors such as smoking or consumption of unhealthy diet.[1,5] Lack of registration in the oral health care system was also implicated in poor oral health of ethnic minorities, particularly African Americans.[6] On the other hand, ethnic health inequalities in the United States have been attributed to other factors such as socioeconomic position (SEP),[7] area characteristics,[8] and racial discrimination.[9,10] For oral health, income and education were found to partially explain US ethnic health inequalities.[4,11]

To address the lack of access to health care for some populations in the United States, the US Affordable Care Act (ACA)[12] included a dependent coverage policy for Americans aged 19-25 years that allowed access and benefits to dental care. Research has shown an association between the ACA policy and increase in dental care use and private dental benefits, and decrease in the financial barriers on young Americans to access dental care.[13] Considering these observations, we postulate that ethnic variations in tooth loss and the role of socioeconomic factors have been lessened in recent years after the implementation of ACA. To test this hypothesis, we set out to exam-

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ine ethnic variations in tooth loss among American adults aged <40 years. Thus, the objectives of our study were: 1) to assess ethnic differences in tooth loss among American adults aged <40 years; 2) to examine whether family income and education level (SEP) attenuate ethnic differences in tooth loss; and 3) to examine whether health insurance attenuates ethnic differences in tooth loss.

Methods

We used data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS), a nationally representative survey of the US population. The BRFSS is a telephone interview that collects data from non-institutionalized American adults aged >18 years. Data obtained from the BRFSS are mainly related to health, preventive services and chronic conditions associated with risk behaviors. To maintain validity, representativeness and coverage of the BRFSS data, a new weighting methodology was used to increase the representativeness and reduce the potential for selection bias.

Outcome Variable

The main outcome used in this study is tooth loss. Participants were asked: "How many of your permanent teeth have been removed because of tooth decay or gum disease? Include teeth lost to infection, but do not include teeth lost for other reasons, such as injury or orthodontics." Answers for tooth loss were: 1) 1-5; 2) 6 or more but not all; 3) All; 4) None; 5) Don't know/ Not sure; or 6) Refused. Given the younger age group included in this study (18-39 years), and lower probabilities of losing teeth at this age, tooth loss was modified into a dichotomous variable indicating missing at least one tooth vs no tooth loss. Those who refused or participants not certain of the tooth loss were considered as missing values.

Main Explanatory Variable

Ethnicity was the main explanatory variable. The original variable of ethnicity included five groups: 1) White; 2) Blacks; 3) Hispanics; 4) Other race; and 5) Multiracial. For the purpose of this study, other race and multiracial were combined in one group; Others. Participants who refused to answer or were not sure of their ethnic group were categorized as missing values.

Considering these observations, we postulate that ethnic variations in tooth loss and the role of socioeconomic factors have been lessened in recent years after the implementation of ACA

Covariates and Confounders

Demographic characteristics, such as age and sex were used in the analysis. The analysis was limited to those aged <40 years. Age groups used in the analyses were: 1) 18-24; 2) 25-29; 3) 30-34; and 4) 35-39. Income and education were used as indications for SEP. Income was categorized to include three groups: low income (<$25,000); medium income ($25,000 to <$50,000); and high income (>$50,000). Education groups were: 1) <12 years of education; 2) high school/some college years; and 3) college or more.

Other covariates included smoking and diabetes because of their known relationship with tooth loss. Smoking had three groups: current smoker; former smoker (who smoked >100 cigarettes); and never smoked. Diabetes indicated self-reported diagnosis of diabetes vs non-diabetic. Dental visits and health insurance were used to indicate access and use of services. Dental visits indicated visits for routine check-ups within the past 12 months vs less often or never. Health insurance variable indicated if participants had any type of health care coverage, that include government plans such as Medicare, or health insurance, prepaid plans such as HMOs (Health Maintenance Organizations), or Indian Health Services. The variable was categorized to indicate whether participants had any health care coverage or not.

Data Analysis

Cluster, stratification and sample weights provided for both combined cellular phones and landline telephones were used to account for the complexity of the survey. We used data weighting in our statistical procedures to ac-

Table 1. Variables distribution and percentages of tooth loss, BRFSS 2014, N=76,273

Variables		Overall% (95%CI)	Tooth loss (95%CI)	P
Sex	Male	51% (50.3, 51.5)	23.3% (22.6, 24.1)	<.001
	Female	49% (48.4, 49.6)	25.2% (24.5, 26)	
Age	18-24	30.1% (29.6, 30.8)	12.0% (11.2, 12.8)	<.001
	25-29	22.8% (22.3, 23.3)	23.7% (22.6, 24.9)	
	30-34	25.0% (24.8, 26)	30.2% (29.1, 31.3)	
	35-39	21.5% (21.1, 22.0)	35% (33.7, 36.1)	
Ethnicity	White	56.7% (56.1, 57.4)	20.8% (20.2, 21.4)	<.001
	Black	12.1% (11.7, 12.6)	33.7% (31.5, 35.0)	
	Hispanic	21.4% (20.8, 22.0)	29.1% (27.7, 30.6)	
	Others	9.6% (9.1, 10.0)	22.0% (20.3, 23.8)	
Income	< $25,000	33.4% (32.8, 34.0)	33.4% (32.4, 34.5)	<.001
	$25,000- <$50,000	25.3% (24.8, 26.0)	25.2% (24.2, 26.3)	
	≥$50,000	41.1% (40.5, 41.7)	16.2% (15.5, 17.0)	
Education	<12	12.8% (12.3, 13.3)	44.1% (42.0, 46.2)	<.001
	High school/some college years	60.8% (60.2, 61.4)	24.6% (24.0, 25.3)	
	College or more	26.4% (26.0, 26.8)	13.9% (13.2, 14.5)	
Smoking	Current smoker	20.5% (20.0, 21.0)	38.5% (37.2, 40.0)	<.001
	Former smoker	14.5% (14.1, 15.0)	28.0% (26.5, 29.3)	
	Never smoked	65.0% (64.3, 65.5)	19.0% (18.3, 19.5)	
Diabetes	Absent	97.8% (97.6, 98.0)	24.0% (23.3, 24.4)	<.001
	Present	2.1% (2.0, 2.3)	41.1% (37.1 45.1)	
Dental visits	Less often or never	37.3% (36.8, 38.1)	26.3% (25.4, 27.2)	<.001
	Within the last 12 months	62.5% (62.0, 63.1)	23.0% (22.4, 23.7)	
Health insurance	No	20.3% (19.7, 20.8)	34.2% (32.8, 35.0)	<.001
	Yes	79.7% (79.1, 80.2)	21.7% (21.1, 22.3)	

count for sampling bias. The analysis was limited to those with complete data in all included variables.

First, a descriptive analysis assessed the distribution of all variables for all participants and by tooth loss (one or more tooth). Second, a set of logistic regression models were constructed to test the association between the outcome (tooth loss) and ethnicity. The first model was adjusted for demographic factors, namely age, sex, and ethnicity. The second model was further adjusted for smoking and diabetes. The third model was additionally adjusted for health insurance and dental visits. Lastly, the forth model was additionally adjusted for income and education.

Results

The analysis included 76,273 participants who answered all the questions. Table 1 shows the distribution of demographic and socioeconomic characteristics, related risk factors, and the percentage of tooth loss. The majority of participants were White (56.7%: 95%CI: 56.1-57.4), Blacks were 12.1% (95%CI: 11.7-12.6), Hispanics were 21.4% (95%CI: 20.8-22.0), and Others were 9.6% (95%CI: 9.1-10.0). Forty-nine percent of participants were females, of them 25.2% (95%CI: 24.5-26) had tooth loss. Males had lower prevalence of tooth loss 23.3% (95%CI: 22.6-24.1). Black Americans showed the highest percentage of tooth loss (33.7%: 95%CI: 31.5-35.0), while Whites had the lowest prevalence (20.8%: 95%CI: 20.2-21.4). A third (33.4%) of those in the low-income group reported tooth loss; tooth loss declined gradually at higher income levels. Similarly, tooth loss was notably higher among participants with the lowest

level of education compared with those with a high school/some college or more education. 44.1% vs 24.6% and 13.9%, respectively. Tooth loss was also higher among current smokers than never smokers, and among those who visited the dentist less often (Table 1).

Table 2 exhibits the results from the logistic regression models. Black Americans were almost twice as likely (OR 1.98; 95%CI:1.8-2.16) to have tooth loss compared with White Americans after adjusting for demographic characteristics, while Hispanics and 'other ethnicities' had odds of 1.61 (95%CI: 1.48-1.74) and 1.13 (95%CI: 1.02-1.26), respectively. However, after adjusting for income and education (Model 4), the odds ratios were attenuated to 1.71 (95%CI: 1.55-1.90) for Black Americans, 1.12 (95%CI: 1.02-1.24) for Hispanics, and 1.34 (95%CI: 1.20-1.50) for other ethnicities.

Those who did not visit a dentist within the past 12 months were more likely to have tooth loss (1.12: 95%CI: 1.05-1.20) compared with those who visited within 12 months. Participants who finished college or had higher education levels were less likely (OR .30; 95%CI: .25-.32) to have tooth loss compared with those who had <12 years of education (Table 2).

Discussion

This study demonstrated that ethnic inequalities in tooth loss existed in a nationally representative sample of US adults aged <40 years. African Americans were more likely to lose their teeth than those from other ethnic groups. Similarly, Hispanic Americans had a higher prevalence of tooth loss than Whites. Interestingly, the significant association between ethnicity and tooth loss persisted even after adjusting for SEP. The prevalence of tooth loss was also higher among current smokers and those with lower SEP or diabetes. Additionally, those

Table 2. Logistic regression analysis presenting odds ratios and 95% CI for factors associated with tooth loss among adults in the United States, BRFSS 2014, N= 76,273

Variables		Model 1	Model 2	Model 3	Model 4
Sex	(ref group Male)	1.06[b] (1.00-1.13)	1.17[a] (1.10-1.25)	1.20[a] (1.12-1.27)	1.12[a] (1.05-1.20)
Age (ref group 18-24)	25-29	2.29[a] (2.07-2.53)	2.12[a] (2.11-2.35)	2.12[a] (2.11-2.34)	2.52[a] (2.26-2.80)
	30-34	3.22[a] (3.03-3.53)	3.23[a] (2.65-3.21)	3.03[a] (2.66-3.23)	3.66[a] (3.31-4.05)
	35-39	4.00[a] (3.65-4.40)	3.78[a] (3.43-4.16)	3.86[a] (3.51-4.25)	5.01[a] (4.52-5.54)
Ethnicity (ref group White)	Black	1.98[a] (1.81-2.16)	2.20[a] (1.29-2.40)	2.12[a] (1.93-2.33)	1.71[a] (1.55-1.90)
	Hispanic	1.61[a] (1.48-1.74)	1.84[a] (1.70-2.00)	1.65[a] (1.51-1.80)	1.12[c] (1.02-1.24)
	Others	1.13[a] (1.02-1.26)	1.27[a] (1.13-1.42)	1.27[a] (1.14-1.42)	1.34[a] (1.20-1.50)
Smoking (ref group current smoker)	Former smoker		.54[a] (0.50-0.60)	.56[a] (0.51-0.61)	.68[a] (0.61-0.74)
	Never smoked		.34[a] (0.32-0.37)	.35[a] (0.33-0.38)	.46[a] (0.42-0.50)
Diabetes	Non-diabetic		1.65[a] (1.37-2.04)	1.67[a] (1.38-2.02)	1.39[b] (1.14-1.68)
Health insurance	No health insurance			.60[a] (0.55-0.65)	.82[a] (0.75-0.90)
Dental visits	(ref group less often or never)			1.12[a] (1.05-1.20)	1.34[a] (1.25-1.44)
Income (ref group < $ 25,000)	$25,000-<50,000				.74[a] (0.68-0.80)
	> $ 50,000				.50[a] (0.45-0.53)
Education (ref group <12 years of education)	High school/some college years				.56[a] (0.51-0.63)
	College or more				.30[a] (0.25-0.32)

Model 1: adjusting for gender, age and ethnicity.
Model 2: model 1 + smoking and diabetes.
Model 3: model 2 + health insurance and dental visits.
Model 4: model 3 + income and education.
a. P<.001.
b. P<.01.
c. P<.05.

who had health insurance were at lower odds for tooth loss than those who did not have health insurance.

Similar to evidence from a systematic review on socioeconomic determinants of tooth loss among adults,[11,14] we found that, after adjusting for income and education, probabilities of missing at least one tooth attenuated but remained significant indicating an association between being Black American and tooth loss. Our findings are also consistent with another study on tooth loss that demonstrated highest prevalence of complete tooth loss among Blacks compared with Whites and Mexican Americans.[15] Yet, our study demonstrated these ethnic differences among younger age groups. Interestingly, despite the implementation of ACA and other the US demographic changes, the findings on the role of SEP in ethnic differences in oral health were consistent with findings from earlier studies.[4]

One of the aims of the introduction of the ACA in the USA was to reduce ethnic and socioeconomic inequalities in insurance coverage by extending dental health coverage and use.[6] After implementation of the ACA, evidence from low-income Latino patients has shown that Hispanics had the largest rate of insurance coverage compared with all other ethnic groups.[13] However in our study, although we did not assess dental insurance coverage, there was no evidence to suggest that ethnic inequalities in tooth loss or that the role of SEP had changed compared with observations from earlier studies.[12] Having said this, it is worth noting that tooth loss is a cumulative condition and the condition could have pre-existed the ACA.

Furthermore, Barbato and Peres[16] have suggested that exposure to adverse environments, such as poor socioeconomic conditions in early life, can contribute to oral health problems specifically tooth loss throughout a lifetime. Although we used a younger age group, it may appear that tooth loss could have happened earlier than ACA. However, since the implementation of the ACA, states that expanded dental benefits for Medicaid patients have shown an increase in use of dental care.[17] On the other hand, the future of access to dental care is extremely complex across states, services, and clients. Although our analysis was adjusted for dental visits and health insurance, the types of services received during the dental visits were not included in the analysis. These services could contribute to health outcomes and hence explain the persistent inequality in tooth loss. Earlier studies in the United States and United Kingdom have suggested that ethnic minorities and those at the bottom of the social hierarchy are less likely to receive preventive care and more likely to have decisive treatment such as tooth extraction when they visit a dentist.[18,19] It is also possible that ethnic minorities in the United States usually tend to seek definitive treatments, such as dental extractions, to avoid financial burden of indirect cost, such as cost of transportation, off-work times, and multiple visits that could play a role as potential barriers for restorative or preventive dental services. These aforementioned factors could have all contributed to the ethnic disparities in tooth loss observed here.

Sex difference in tooth loss was also noticed in this study. It is known that women tend to seek general and oral services more often than men;[20] however, frequent dental visits of women could contribute to more dental extractions. This may also explain why women had higher prevalence of tooth loss than men.

Much of the literature on tooth loss has examined participants from a wide range of age. Our study, however, focused on younger adults aged between 18-39 years, highlighting the significance that tooth loss is less likely to be experienced at early age, and to highlight that tooth loss is not due to natural process of aging.

This study demonstrated that ethnic inequalities in tooth loss still exist in a nationally representative sample of US adults aged <40 years.

Limitations

There are few limitations of this study. First, the nature of the cross-sectional survey does not allow conclusions on temporality. Second, our dataset contained no information on dental insurance. Self-reported data have the potential of recall or report bias. However, self-reporting

in BRFSS was found to have moderate validity with slight differences over other national surveys.[21] Moreover, validation of self-reported oral health conditions, such as tooth loss, is achieved by combining it with high agreement of clinical examinations that reflect clinical status.[22]

Conclusions

The findings of this study were based on a large representative sample of American adults from different states that could achieve generalizability. The analysis also accounted for several factors related to tooth loss to establish the independent relationship between ethnicity and tooth loss. Our findings clearly demonstrate that, in 2014, ethnic inequality in tooth loss still existed among a large sample of younger adults while also illustrating the role of socioeconomic conditions in ethnic inequalities.

Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Nazer, Sabbah; Data analysis and interpretation: Nazer, Sabbah; Manuscript draft: Nazer, Sabbah

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