

## Disparities in Oral Cancer Screening Among Dental Professionals: NHANES 2011–2016



Avni Gupta, BDS, MPH,<sup>1</sup> Stephen Sonis, DMD, DMSc,<sup>2,3</sup> Ravindra Uppaluri, MD, PhD,<sup>4,5</sup>  
Regan W. Bergmark, MD,<sup>1,4,5,6</sup> Alessandro Villa, DDS, PhD, MPH<sup>2,3</sup>

**Introduction:** As early detection of oral cancers is associated with better survival, oral cancer screening should be included in dental visits for adults. This study examines the rate and predictors of oral cancer screening exams among U.S. adults with a recent dental visit.

**Methods:** Individuals aged  $\geq 30$  years who received a dental visit in the last 2 years, in the 2011–2016 National Health and Nutrition Examination Survey were analyzed in December 2018. Weighted multivariable logistic regression models examined the likelihood of intraoral and extraoral oral cancer screening exams, adjusting for age, sex, race/ethnicity, education, marital status, poverty income ratio, health insurance, tobacco smoking, and alcohol consumption. Subgroup analyses were conducted among races/ethnicities, smokers, and alcohol consumers. Statistical significance was set at  $p < 0.01$ .

**Results:** A total of 37.6% and 31.3% reported receiving an intraoral and extraoral oral cancer screening exam, respectively. Minority racial/ethnic groups versus white, non-Hispanics, less-educated versus more-educated, uninsured and Medicaid-insured versus privately insured, and low-income versus high-income participants were less likely to have received intraoral or extraoral oral cancer screening exams. There was no difference in the likelihood of being screened based on smoking status. Alcohol consumers were more likely to be screened. Among subgroups, less-educated and low-income individuals were less likely to be screened.

**Conclusions:** A significantly higher proportion of minority race/ethnicity and low SES individuals report not receiving an oral cancer screening exam, despite a recent dental visit. This selective screening by dental professionals is incompliant with guidelines and concerning because these groups are more likely to present with an advanced stage of oral cancer at diagnosis. An understanding of the reasons for discriminatory oral cancer screening practices could help develop effective interventions.

*Am J Prev Med 2019;57(4):447–457. © 2019 American Journal of Preventive Medicine. Published by Elsevier Inc. All rights reserved.*

### INTRODUCTION

Oral cancers (OCs) account for about 2% of all malignancies and 1.2% of all cancer-associated deaths in the U.S.<sup>1</sup> Early stage OCs have significantly better 5-year survival rates (82.8%) than those involving regional tissues/lymph nodes (50%) or those that have metastasized (28%).<sup>2</sup> Therefore, early detection of OCs is highly desirable.<sup>3</sup>

Although the U.S. Preventive Services Task Force does not support oral cancer screening (OCS) in primary care settings,<sup>4</sup> the American Dental Association issued guidelines in

From the <sup>1</sup>Center for Surgery and Public Health, Brigham and Women's Hospital, Boston, Massachusetts; <sup>2</sup>Division of Oral Medicine, Brigham and Women's Hospital and Dana-Farber Cancer Institute, Boston, Massachusetts; <sup>3</sup>Department of Oral Medicine, Infection, and Immunity, Harvard School of Dental Medicine, Boston, Massachusetts; <sup>4</sup>Division of Otolaryngology-Head and Neck Surgery, Brigham and Women's Hospital and Dana-Farber Cancer Institute, Boston, Massachusetts; <sup>5</sup>Department of Otolaryngology, Harvard Medical School, Boston, Massachusetts; and <sup>6</sup>Patient Reported Outcomes, Value, and Experience Center, Brigham and Women's Hospital, Boston, Massachusetts

Address correspondence to: Avni Gupta, BDS, MPH, Center for Surgery and Public Health, Brigham and Women's Hospital, One Brigham Circle, 1620 Tremont Street 4-020, Boston MA 02120. E-mail: [avnigup07jan@gmail.com](mailto:avnigup07jan@gmail.com).

0749-3797/\$36.00

<https://doi.org/10.1016/j.amepre.2019.04.026>

2010 that “clinicians remain alert for signs of potentially malignant lesions or early-stage cancers while performing routine visual and tactile examinations in all patients, but particularly in those who use tobacco or who consume alcohol heavily.”<sup>5</sup> Later, the guidelines concluded that performing an intraoral and extraoral conventional visual and tactile examination in all adult patients was “good practice.”<sup>6</sup> The American Academy of Oral Medicine also supports noninvasive oral mucosal examination by oral healthcare providers as part of the standard initial and recall examination for all patients.<sup>7</sup>

Studies have shown that most OCSs are performed by dental professionals,<sup>8</sup> and that patients who report visiting a dentist are more likely to be screened,<sup>9</sup> and be diagnosed at earlier cancer stages,<sup>10</sup> than those with no dental visit. However, there appear to be racial/ethnic<sup>8,9,11</sup> and economic<sup>8</sup> disparities in OCS rates. Racial/ethnic<sup>12</sup> and economic disparities<sup>13</sup> also have been shown in access to dental care, and it is unknown if disparities in OCS rates are a result of lack of access to dental care.

The study examines OCS rates and their sociodemographic predictors among U.S. adults who reported visiting a dental clinic in the last 2 years. The hypothesis is that all individuals who have recently visited a dental clinic would report having received an OCS exam.

## METHODS

### Study Sample

National Health and Nutrition Examination Survey (NHANES) data were pooled from 3 data cycles: 2011–2012, 2013–2014, and 2015–2016. NHANES is a series of ongoing cross-sectional surveys approved by the National Center for Health Statistics Research Ethics Review Board.<sup>14</sup> It examines approximately 5,000 people every year across the U.S. and is designed to be nationally representative of the civilian, non-institutionalized U.S. population.

Individuals aged  $\geq 30$  years were included in the analysis because NHANES collects information on OCS examination from subjects who are in this age group. To account for the year screening guidelines were first published by the American Dental Association,<sup>5</sup> only those who reported a dental visit within the last 2 years were included. Those who did not respond to the question about OCS exams were excluded.

### Measures

Two self-reported outcomes were examined:

1. Intraoral OCS exam was computed as *yes* or *no* to the survey question: *Have you/Has sample person ever had an exam for oral cancer in which the doctor or dentist pulls on (your/his/her) tongue, sometimes with gauze wrapped around it, and feels under the tongue and inside the cheeks?*
2. Extraoral OCS exam was computed as *yes* or *no* to the survey question: *Have you/Has sample person ever had an exam for*

*oral cancer in which the doctor or dentist feels your/his/her neck?*

Extraoral OCS exam data were available from 2011 to 2014.<sup>14</sup> Studied predictors included were as follows:

1. race/ethnicity (Mexican American; other Hispanic; white, non-Hispanic [WNH]; black, non-Hispanic; Asian, non-Hispanic; other races);
2. sex (male, female);
3. age group (30–44 years, 45–64 years,  $\geq 65$  years);
4. marital status (married/living with partner, never married, widowed/separated/divorced)<sup>15</sup>;
5. education status (for the main analysis, education level was categorized into less than high school, high school graduate or equivalent, more than high school graduate<sup>15,16</sup>; for sensitivity analysis, into less than high school educated, high school educated or equivalent, some college or associate’s degree, college or above<sup>8</sup>); and
6. health insurance (uninsured, private, Medicare, Medicaid, others).

Income status was determined using poverty income ratio (PIR) computed as a continuous variable and calculated by “dividing family income by the federal poverty threshold specific to family size and calendar year, as defined by the U.S. Census Bureau.”<sup>17</sup> Smoking status was categorized into never, former, and current, based on reported smoking of  $\geq 100$  cigarettes in the participant’s lifetime and whether they were smoking cigarettes at the time of taking the survey. Alcohol consumption was measured as the number of drinks consumed per week in the past 12 months and was categorized into 0, 1–7, 8–14, and  $>14$ .<sup>15,18</sup> For subgroup analysis, alcohol consumption was categorized into those who did not report alcohol use (0 drinks per week) and those who reported any level of alcohol use (at least 1 drink per week). NHANES defines “drink” as “what the sample person considers a drink to be; for example, a glass or a can of beer, a glass of wine, a shot of hard liquor, or a mixed drink. It does not include drinking small amounts of wine for religious purposes.”<sup>19</sup>

### Statistical Analysis

National Center for Health Statistics analytical guidelines were used to weigh the analysis for national-level estimates by using 2-year interview sample weights. Weights were constructed for 3 and 2 data cycles for analyzing intraoral and extraoral exams, respectively. Sample characteristics are reported as weighted proportions and unweighted sample size. Sample characteristics of an OCS exam were examined by Pearson chi-square tests with Rao–Scott correction. Rao–Scott is a corrected/design-adjusted version of a typical Pearson chi-square. It accounts for violations of equal probability across survey data and is recommended for analysis of complex survey data such as NHANES that uses multi-stage sampling.<sup>20,21</sup> Multivariate logistic regression models were constructed to study the association between predictors and OCS examination. RRs were computed to determine the risk or likelihood of being screened; hence, a lower RR referred to a lower likelihood of being screened. Subgroup analysis was conducted among racial/ethnic groups, current and former smokers, and alcohol consumers. Statistical analyses were performed in

December 2018 using Stata, version 14. Statistical tests were two-sided, and  $p < 0.01$  was considered statistically significant. The study was approved by the IRB at Partners Healthcare.

## RESULTS

A total of 29,902 individuals were sampled from 2011 to 2016 in NHANES. Of these, 26.6% (7,945) who reported no dental visit in the last 2 years and 4.2% (1,261) with missing data for the last dental visit were excluded. A total of 11,296 individuals aged <30 years were excluded. Missing data on intraoral and extraoral OCS exams excluded 63 and 87 individuals, respectively, leaving 9,337 individuals representing 133,295,998 civilian, non-institutionalized U.S. population for intraoral exams, and 6,259 individuals representing 132,546,822 civilian, non-institutionalized U.S. population for extraoral exams.

Most of the individuals were aged 45–64 years, female, WNH, married/living together, more than high school educated, never smokers, consuming 1–7 drinks per week, and privately insured. The mean PIR was 3.38 (95% CI=3.26, 3.49) and 3.34 (95% CI=3.19, 3.49), respectively, for the intraoral and extraoral exam samples (Table 1).

Only 37.6% reported being screened for OC through an intraoral exam, and 31.3% received an extraoral exam. Age, race/ethnicity, education level, PIR, smoking status, alcohol use, and insurance status were associated with being screened by intraoral and extraoral OC exam. Sex was associated with intraoral exam (Table 2).

Analysis was adjusted for age, sex, race/ethnicity, PIR, education, smoking status, number of alcoholic drinks per week, marital status, and insurance status. Minority racial/ethnic groups had a lower likelihood of reporting having received an intraoral exam. The estimated likelihoods of reporting OCS compared with WNHs were RR=0.28 (95% CI=0.20, 0.39) for Mexican Americans; RR=0.31 (95% CI=0.23, 0.43) for other Hispanics; RR=0.39 (95% CI=0.30, 0.52) for black, non-Hispanics; RR=0.27 (95% CI=0.20, 0.37) for Asian, non-Hispanics; and RR=0.47 (95% CI=0.29, 0.76) for other races (Table 3).

Less than high school educated individuals (RR=0.40, 95% CI=0.26, 0.62) and high school graduates (RR=0.65, 95% CI=0.54, 0.78) were less likely to report an intraoral exam than more than high school educated respondents. The likelihood of reporting being screened increased with an increase of 1.00 in the PIR (RR=1.18, 95% CI=1.11, 1.25). Uninsured (RR=0.47, 95% CI=0.31, 0.72) and Medicaid-insured (RR=0.55, 95% CI=0.37, 0.81) individuals were less likely to report being screened than privately insured individuals. Reported screening rates of former, current, or never smokers were not

statistically different. However, compared with those who did not report consuming alcohol, those consuming 1–7 (RR=1.42, 95% CI=1.11, 1.82) and 8–14 (RR=1.48, 95% CI=1.11, 1.96) drinks per week were more likely to be screened (Table 3).

Among different racial/ethnic groups, less-educated and low-income individuals reported lower likelihood of an intraoral exam. Among current and former smokers, as well as among those consuming alcohol, less-educated, low-income, and racial/ethnic minority respondents were less likely to report intraoral OCS (Table 3).

Minority racial/ethnic groups had a lower likelihood of reporting having received an extraoral exam. The estimated likelihoods of reporting OCS compared with WNHs were RR=0.30 (95% CI=0.18, 0.49) for Mexican Americans; RR=0.59 (95% CI=0.39, 0.88) for other Hispanics; and RR=0.39 (95% CI=0.27, 0.56) for Asian, non-Hispanics. Respondents with less than high school education were less likely to report being screened than those with more than high school education (RR=0.36, 95% CI=0.24, 0.53). Uninsured individuals were less likely than privately insured respondents to be screened (RR=0.62, 95% CI=0.45, 0.87). No differences were seen in the reported screening rates of former, current, or never smokers. Those consuming 1–7 drinks per week were more likely to be screened than those not consuming alcohol (RR=1.37, 95% CI=1.12, 1.69) (Table 4).

Among different racial/ethnic groups, less-educated individuals were less likely to report an extraoral exam. Among current and former smokers, as well as among those consuming alcohol, racial/ethnic minority, less-educated, and low-income respondents reported a lower likelihood of an extraoral exam (Table 4).

After excluding alcohol use from multivariable regression models, the population subgroups that were less likely to report being screened for intraoral (Appendix Table 1, available online) and extraoral OCS exams (Appendix Table 2, available online) did not change.

Computing education as 4 categories instead of 3 in the multivariable regression models, findings did not differ. Less-educated, racial/ethnic minority, uninsured, and Medicaid patients were less likely to be screened. Smoking was unassociated with OCS, and those drinking 1–7 drinks per week were more likely to be screened than those not consuming alcohol.

## DISCUSSION

Approximately one third of U.S. adults who have recently visited a dental practice reported receiving an OCS exam. The American Dental Association recommends that dental professionals perform OCS exams on all adults as a standard procedure during dental visits.<sup>5</sup>

**Table 1.** Intra- and Extra-oral Exam Sample Characteristics

Characteristic	Intraoral exam, <sup>a</sup> % (n)	Extraoral exam, <sup>b</sup> % (n)
Age, years		
30–44	31.5 (2,929)	32.3 (1,987)
45–64	45.1 (3,914)	45.4 (2,631)
≥65	23.3 (2,494)	22.3 (1,641)
Sex		
Male	45.5 (4,232)	45.5 (2,858)
Female	54.5 (5,105)	54.5 (3,401)
Race		
Mexican American	6.0 (1,067)	5.9 (596)
Other Hispanic	5.2 (1,021)	5.1 (608)
White, non-Hispanic	70.6 (3,709)	71.6 (2,675)
Black, non-Hispanic	9.9 (1,992)	9.8 (1,352)
Asian, non-Hispanic	5.6 (1,293)	5.4 (881)
Other race	2.6 (255)	2.1 (147)
Marital status <sup>c</sup>		
Married/living together	70.4 (6,100)	70.1 (4,073)
Never married	9.7 (1,043)	9.6 (693)
Widowed/divorced	19.9 (2,188)	20.3 (1,487)
Education <sup>d</sup>		
Less than high school	11.1 (1,773)	11.9 (1,155)
High school or equivalent	18.8 (1,863)	19.2 (1,271)
More than high school	69.7 (5,695)	68.8 (3,828)
Poverty income ratio, mean (95% CI) (n) <sup>e</sup>	3.38 (3.26, 3.49) (8,484)	3.34 (3.19,3.49) (5,739)
Alcohol use in past 12 months, average number of drinks per week <sup>f</sup>		
0	16.5 (1,410)	16.7 (960)
1–7	34.8 (2,294)	34.8 (1,552)
8–14	26.5 (1,597)	25.8 (1,056)
>14	22.2 (1,522)	22.6 (1,035)
Smoking status <sup>g</sup>		
Never	57.0 (5,486)	56.9 (3,643)
Former	28.1 (2,430)	27.9 (1,646)
Current	14.9 (1,413)	15.0 (965)
Health insurance status		
Uninsured	9.9 (1,215)	11.3 (909)
Private	57.0 (4,419)	58.2 (3,032)
Medicare	20.7 (2,044)	19.4 (1,335)
Medicaid	6.0 (944)	5.8 (594)
Other	6.3 (715)	5.3 (389)

<sup>a</sup>Sample size for intraoral exam (years 2011–2016): n=9,337, representing 133,295,998 at U.S. level.

<sup>b</sup>Sample size for extraoral exam (years 2011–2014): n=6,259, representing 132,546,822 at U.S. level.

<sup>c</sup>Marital status is missing for 0.0004%.

<sup>d</sup>Education level is missing for 0.0004%.

<sup>e</sup>Poverty level is missing for 6.9%.

<sup>f</sup>Alcohol use is missing for 21.2%.

<sup>g</sup>Smoking status is missing for 0.0007%.

Not only was the overall prevalence of OCS low, but there were also stark differences in who was examined. Racial/ethnic minority, low-income, less-educated, and uninsured or publicly insured individuals were less likely to be screened for OC. These differences were independent of the high-risk behaviors for OC, such as smoking

and alcohol consumption. The existence of these disparities indicates a lack of compliance of dental professionals with the OCS guidelines and highlights possible selection of patients by dentists based on their SES. These findings are important because oral premalignant and cancerous lesions can be detected in an outpatient

**Table 2.** Proportion of Individuals Receiving Intra- and Extra-oral Exams for Each Sample Characteristic

Characteristic	Proportion receiving intraoral exam		Proportion receiving extraoral exam	
	%	p-value	%	p-value
Age, years				
30–44	28.1	<b>&lt;0.001</b>	23.8	<b>&lt;0.001</b>
45–64	40.6		33.3	
≥65	44.7		38.1	
Sex				
Male	35.4	<b>&lt;0.01</b>	30.3	0.214
Female	39.5		32.2	
Race				
Mexican American	10.0	<b>&lt;0.001</b>	9.6	<b>&lt;0.001</b>
Other Hispanic	13.2		17.1	
White, non-Hispanic	46.5		36.4	
Black, non-Hispanic	18.6		24.1	
Asian, non-Hispanic	16.0		17.2	
Other race	27.6		22.4	
Marital status				
Married/living together	40.8	<b>&lt;0.001</b>	33.8	<b>&lt;0.001</b>
Never married	27.5		22.7	
Widowed/divorced	31.3		26.8	
Education				
Less than high school	12.3	<b>&lt;0.001</b>	12.3	<b>&lt;0.001</b>
High school or equivalent	29.0		28.4	
More than high school	44.1		35.5	
Poverty income ratio (mean, 95% CI)	3.93 (3.83, 4.04)	<b>&lt;0.001</b>	3.75 (3.59, 3.91)	<b>&lt;0.001</b>
Alcohol use in past 12 months, average number of drinks per week				
0	30.5	<b>&lt;0.001</b>	27.6	<b>&lt;0.001</b>
1–7	46.4		39.7	
8–14	45.2		35.1	
>14	32.0		27.7	
Smoking status				
Never	38.3	<b>&lt;0.001</b>	31.4	<b>&lt;0.01</b>
Former	42.5		35.3	
Current	25.9		23.4	
Health insurance status				
Uninsured	15.2	<b>&lt;0.001</b>	15.3	<b>&lt;0.001</b>
Private	42.6		33.9	
Medicare	44.1		37.2	
Medicaid	14.3		18.2	
Other	28.5		29.8	

Note: Boldface indicates statistical significance ( $p < 0.01$ ). Proportions represent the population-level proportion of sample that received an intra- or extra-oral cancer screening exam for each sample characteristic listed the first column (row %).

OCS exam and are likely to have better outcomes if diagnosed earlier.<sup>22,23</sup>

*Healthy People 2020* reported the overall screening rate for OC in the U.S. as very low and racial/ethnic disparities in the detection of OC in the earliest stages, with white, non-Hispanic or Latino groups having the highest likelihood of early stage detection.<sup>24</sup> Previous studies have shown limited OCS among those with low income,

less education, and racial/ethnic minorities.<sup>8,9,11,25</sup> This study found that within each race/ethnicity, being poor, less educated, and uninsured placed an individual at the highest risk of not being screened. Education and income have been shown to be strong predictors of breast and cervical cancer screening in different racial/ethnic groups in the previous studies.<sup>26</sup> Low-income, less-educated, and racial/ethnic minority individuals are

**Table 3.** Adjusted Associations With Intraoral Cancer Screening Exam

Characteristic	All sample, <sup>a</sup> RR (95% CI)	MA, <sup>b</sup> RR (95% CI)	OH, <sup>b</sup> RR (95% CI)	WNH, <sup>b</sup> RR (95% CI)	BNH, <sup>b</sup> RR (95% CI)	ANH, <sup>b</sup> RR (95% CI)	Smokers, <sup>c</sup> RR (95% CI)	Alcohol users, <sup>d</sup> RR (95% CI)
Age, years								
30–44	<b>0.44 (0.30, 0.64)**</b>	0.93 (0.24, 3.57)	0.55 (0.23, 1.32)	<b>0.39 (0.24, 0.63)**</b>	0.94 (0.42, 2.12)	0.43 (0.12, 1.55)	<b>0.33 (0.19, 0.55)**</b>	<b>0.45 (0.32, 0.64)**</b>
45–64	0.64 (0.43, 0.94)	1.13 (0.27, 4.77)	0.52 (0.27, 1.00)	0.59 (0.36, 0.96)	1.14 (0.58, 2.24)	0.60 (0.18, 2.01)	0.55 (0.35, 0.85)	0.68 (0.47, 0.99)
≥65	ref	ref	ref	ref	ref	ref	ref	ref
Sex								
Male	<b>0.71 (0.62, 0.80)**</b>	0.64 (0.32, 1.28)	1.08 (0.63, 1.84)	<b>0.67 (0.57, 0.79)**</b>	0.75 (0.54, 1.02)	0.89 (0.58, 1.37)	0.74 (0.56, 0.97)	<b>0.71 (0.62, 0.83)**</b>
Female	ref	ref	ref	ref	ref	ref	ref	ref
Race								
MA	<b>0.28 (0.20, 0.39)**</b>	—	—	—	—	—	<b>0.42 (0.25, 0.73)*</b>	<b>0.26 (0.19, 0.36)**</b>
OH	<b>0.31 (0.23, 0.43)**</b>	—	—	—	—	—	<b>0.31 (0.21, 0.47)**</b>	<b>0.26 (0.19, 0.35)**</b>
WNH	ref	—	—	—	—	—	ref	ref
BNH	<b>0.39 (0.30, 0.52)**</b>	—	—	—	—	—	<b>0.46 (0.30, 0.68)**</b>	<b>0.36 (0.28, 0.45)**</b>
ANH	<b>0.27 (0.20, 0.37)**</b>	—	—	—	—	—	<b>0.20 (0.11, 0.35)**</b>	<b>0.21 (0.16, 0.27)**</b>
Other races	<b>0.47 (0.29, 0.76)*</b>	—	—	—	—	—	0.53 (0.26, 1.06)	<b>0.58 (0.39, 0.84)*</b>
Marital status								
Married	ref	ref	ref	ref	ref	ref	ref	ref
Never	0.93 (0.71, 1.22)	0.5 (0.12, 2.08)	0.27 (0.07, 1.09)	0.97 (0.69, 1.35)	0.94 (0.65, 1.35)	1.04 (0.47, 2.30)	0.93 (0.64, 1.36)	0.78 (0.60, 1.02)
Widowed/divorced/ separated	<b>0.73 (0.61, 0.87)*</b>	0.88 (0.31, 2.47)	1.37 (0.77, 2.42)	<b>0.68 (0.55, 0.84)**</b>	0.76 (0.57, 1.03)	<b>2.14 (1.18, 3.84)*</b>	<b>0.55 (0.41, 0.74)**</b>	<b>0.71 (0.58, 0.86)*</b>
Education								
Less than high school	<b>0.40 (0.26, 0.62)**</b>	0.32 (0.12, 0.87)	0.60 (0.29, 1.23)	<b>0.42 (0.24, 0.72)*</b>	<b>0.38 (0.20, 0.72)*</b>	<b>0.27 (0.09, 0.78)*</b>	<b>0.34 (0.20, 0.55)**</b>	<b>0.40 (0.28, 0.57)**</b>
High school or equivalent	<b>0.65 (0.54, 0.78)**</b>	0.74 (0.33, 1.62)	0.83 (0.44, 1.54)	<b>0.64 (0.52, 0.79)**</b>	<b>0.48 (0.31, 0.74)*</b>	0.37 (0.10, 1.26)	<b>0.54 (0.42, 0.68)**</b>	<b>0.74 (0.59, 0.93)*</b>
More than high school	ref	ref	ref	ref	ref	ref	ref	ref
PIR	<b>1.18 (1.11, 1.25)**</b>	<b>1.45(1.18, 1.78)**</b>	<b>1.35 (1.11, 1.65)*</b>	<b>1.16 (1.07, 1.24)**</b>	<b>1.27 (1.10, 1.46)*</b>	1.18 (0.96, 1.46)	<b>1.19 (1.09, 1.30)**</b>	<b>1.21 (1.14, 1.28)**</b>
Smoking								
Never	ref	ref	ref	ref	ref	ref	ref	ref
Former	1.05 (0.88, 1.25)	2.04 (0.94, 4.44)	0.85 (0.48, 1.48)	1.02 (0.83, 1.26)	1.53 (1.06, 2.23)	0.54 (0.28, 1.02)	—	1.09 (0.89, 1.34)
Current	0.86 (0.63, 1.17)	<b>3.13 (1.57, 6.26)*</b>	0.75 (0.27, 2.03)	0.84 (0.58, 1.20)	0.78 (0.49, 1.25)	1.34 (0.57, 3.12)	—	0.90 (0.70, 1.17)
Alcohol, average number of drinks per week								
0	ref	ref	ref	ref	ref	ref	ref	—
1–7	<b>1.42 (1.11, 1.82)*</b>	1.81 (0.66, 4.93)	1.03 (0.59, 1.79)	<b>1.53 (1.14, 2.06)*</b>	0.89 (0.56, 1.42)	0.54 (0.31, 0.95)	1.55 (1.11, 2.16)	—
8–14	<b>1.48 (1.11, 1.96)*</b>	0.73 (0.36, 1.50)	1.42 (0.68, 2.96)	<b>1.58 (1.12, 2.22)*</b>	0.84 (0.49, 1.45)	1.04 (0.54, 1.98)	1.57 (1.09, 2.27)	—
>14	1.27 (0.95, 1.69)	1.04 (0.34, 3.15)	0.59 (0.26, 1.32)	1.36 (0.97, 1.89)	1.13 (0.67, 1.87)	0.33 (0.13, 0.83)	1.32 (0.89, 1.96)	—

(continued on next page)

**Table 3.** Adjusted Associations With Intraoral Cancer Screening Exam (continued)

Characteristic	All sample, <sup>a</sup> RR (95% CI)	MA, <sup>b</sup> RR (95% CI)	OH, <sup>b</sup> RR (95% CI)	WNH, <sup>b</sup> RR (95% CI)	BNH, <sup>b</sup> RR (95% CI)	ANH, <sup>b</sup> RR (95% CI)	Smokers, <sup>c</sup> RR (95% CI)	Alcohol users, <sup>d</sup> RR (95% CI)
Health insurance								
Uninsured	<b>0.47 (0.31, 0.72)*</b>	0.86 (0.35, 2.09)	0.60 (0.18, 1.93)	<b>0.44 (0.25, 0.76)*</b>	0.74 (0.37, 1.47)	0.27 (0.08, 0.93)	0.70 (0.42, 1.19)	<b>0.55 (0.36, 0.83)*</b>
Private	0.84 (0.58, 1.20)	1.23 (0.29, 5.11)	1.52 (0.63, 3.66)	0.76 (0.49, 1.17)	1.53 (0.77, 3.02)	1.83 (0.22, 3.04)	0.73 (0.44, 1.23)	0.76 (0.56, 1.04)
Medicare	<b>0.55 (0.37, 0.81)*</b>	0.73 (0.06, 9.22)	1.14 (0.44, 2.90)	<b>0.46 (0.29, 0.73)*</b>	0.83 (0.42, 1.63)	0.58 (0.11, 2.92)	<b>0.51 (0.30, 0.88)*</b>	0.63 (0.42, 0.94)
Other	0.70 (0.50, 0.98)	1.26 (0.38, 4.16)	2.09 (0.84, 5.17)	0.65 (0.41, 1.02)	1.12 (0.61, 2.10)	0.58 (0.17, 1.94)	0.69 (0.48, 1.00)	0.83 (0.58, 1.18)

Note: Boldface indicates statistical significance (\* $p < 0.01$ , \*\* $p < 0.001$ ).

<sup>a</sup>Adjusted for age, sex, race/ethnicity, PIR, education, smoking status, alcoholic drinks per week, marital status, and insurance status.

<sup>b</sup>Adjusted for age, sex, PIR, education, smoking status, alcoholic drinks per week, marital status, and insurance status.

<sup>c</sup>Current and former smokers; adjusted for age, sex, race/ethnicity, PIR, education, alcoholic drinks per week, marital status, and insurance status.

<sup>d</sup>Those who reported any level of alcohol use in the past 12 months; adjusted for age, sex, race/ethnicity, PIR, education, marital status, smoking status, and insurance status. ANH, Asian, non-Hispanics; BNH, black, non-Hispanics; MA, Mexican Americans; OH, other Hispanics; PIR, poverty income ratio; WNH, white, non-Hispanics.

also less likely to have dental visits.<sup>12,13</sup> However, the findings of this study show that these disparities in OCS exist despite a reported dental visit, highlighting inequalities in the delivery of care independent of access to care. These findings raise important questions and concerns regarding selective provision of recommended services.

Uninsured and publicly insured patients are less likely to receive better healthcare services than privately insured patients. These insurance-based disparities have been attributed to the notions of associating public insurance with low income and low educational status. Hence, although public insurance might provide access to care, the stigma associated with it could bias healthcare providers and shape how they deliver care.<sup>27</sup> Such differences in the provision of healthcare services were evident in a qualitative study of the experience of dental patients, where uninsured and publicly insured patients reported that their dental professionals failed to provide recommended services to them because of their limited ability to pay for services.<sup>28</sup>

Less-educated patients might have a lower awareness of OC. Besides having access to a healthcare facility where a screening exam can be performed, an individual's awareness of OC and the need to be screened for it is the most important factor that can influence a person's likelihood of being screened.<sup>3</sup> There are racial/ethnic disparities in knowledge<sup>29,30</sup> and in dentist–patient communications about OC.<sup>30</sup> Racial/ethnic minorities are less likely to receive preventive care information,<sup>31</sup> and fewer OC awareness programs targeted Hispanics in a study among New York City residents.<sup>32</sup>

Patients' SES also can affect dentists' perception of the need for providing OC information and the ability of patients to comprehend this information.<sup>30</sup> Dentists attribute the lack of information exchange with patients to patients' lack of information about or "indifference" to OC. However, African-American patients reported that they need to be informed about OC by dental professionals. This gap in dentists' perception about patients' willingness to be informed and patients' conceptions about the role of dentists in providing information creates challenges for dentists to initiate communication about OC with some population subgroups, who are often high-risk populations.<sup>30</sup> A study on cancer screening barriers among Hispanics and Latinos compared with Caucasians showed that culturally relevant communication to better understand their values and perceptions can increase their participation in cancer screening.<sup>33,34</sup> These population subgroups often lack trust in dentists and blame their lack of sensitivity and their money-mindedness for differentially treating racial/ethnic minorities.<sup>28</sup>

The findings of this study could also be explained by differences in the type of dental practice to which

**Table 4.** Adjusted Associations With Extraoral Cancer Screening Exam

Characteristic	All sample, <sup>a</sup> RR (95% CI)	MA, <sup>b</sup> RR (95% CI)	OH, <sup>b</sup> RR (95% CI)	WNH, <sup>b</sup> RR (95% CI)	BNH, <sup>b</sup> RR (95% CI)	ANH, <sup>b</sup> RR (95% CI)	Smokers, <sup>c</sup> RR (95% CI)	Alcohol users, <sup>d</sup> RR (95% CI)
Age, years								
30–44	<b>0.49 (0.34, 0.71)**</b>	1.01 (0.21, 4.88)	0.54 (0.21, 1.38)	<b>0.45 (0.29, 0.69)*</b>	0.92 (0.49, 1.72)	<b>0.22 (0.06, 0.72)*</b>	<b>0.39 (0.21, 0.74)*</b>	<b>0.48 (0.34, 0.67)**</b>
45–64	0.71 (0.49, 1.03)	0.84 (0.18, 3.97)	0.38 (0.14, 1.04)	0.72 (0.46, 1.13)	0.82 (0.47, 1.44)	0.25 (0.08, 0.82)	0.76 (0.46, 1.23)	0.66 (0.46, 0.96)
≥65	ref	ref	ref	ref	ref	ref	ref	ref
Sex								
Male	0.86 (0.76, 0.98)	1.15 (0.58, 2.27)	0.76 (0.39, 1.48)	0.84 (0.72, 0.98)	1.08 (0.80, 1.46)	1.17 (0.68, 2.01)	0.95 (0.75, 1.21)	0.83 (0.70, 0.98)
Female	ref	ref	ref	ref	ref	ref	ref	ref
Race								
MA	<b>0.30 (0.18, 0.49)**</b>	—	—	—	—	—	<b>0.40 (0.19, 0.83)*</b>	<b>0.35 (0.21, 0.57)**</b>
OH	<b>0.59 (0.39, 0.88)*</b>	—	—	—	—	—	0.61 (0.33, 1.12)	<b>0.54 (0.38, 0.76)**</b>
WNH	ref	—	—	—	—	—	ref	ref
BNH	0.75 (0.56, 1.01)	—	—	—	—	—	0.78 (0.51, 1.20)	<b>0.74 (0.57, 0.94)*</b>
ANH	<b>0.39 (0.27, 0.56)**</b>	—	—	—	—	—	<b>0.35 (0.18, 0.65)*</b>	<b>0.36 (0.26, 0.48)**</b>
Other races	0.63 (0.42, 0.96)	—	—	—	—	—	0.68 (0.37, 1.25)	<b>0.60 (0.39, 0.92)*</b>
Marital status								
Married	ref	ref	ref	ref	ref	ref	ref	ref
Never	0.76 (0.49, 1.10)	0.49 (0.11, 2.29)	0.83 (0.27, 2.47)	0.65 (0.37, 1.14)	1.17 (0.69, 1.98)	1.18 (0.49, 2.83)	1.01 (0.63, 1.63)	0.71 (0.48, 1.05)
Widowed/divorced/separated	0.75 (0.57, 0.99)	<b>3.48 (1.27, 9.52)*</b>	0.87 (0.47, 1.62)	0.69 (0.50, 0.95)	0.81 (0.49, 1.32)	1.80 (0.92, 3.52)	<b>0.56 (0.38, 0.83)*</b>	<b>0.72 (0.56, 0.93)*</b>
Education								
Less than high school graduate	<b>0.36 (0.24, 0.53)**</b>	0.33 (0.08, 1.39)	0.55 (0.20, 1.53)	<b>0.33 (0.12, 0.56)**</b>	<b>0.37 (0.21, 0.64)**</b>	0.96 (0.35, 2.62)	<b>0.32 (0.18, 0.57)**</b>	<b>0.35 (0.24, 0.51)**</b>
High school graduate or equivalent	0.85 (0.67, 1.06)	0.84 (0.28, 2.48)	0.89 (0.35, 2.28)	0.90 (0.68, 1.19)	<b>0.47 (0.32, 0.68)**</b>	0.84 (0.28, 2.46)	0.88 (0.58, 1.33)	0.94 (0.76, 1.15)
More than high school graduate	ref	ref	ref	ref	ref	ref	ref	ref
PIR	1.08 (0.99, 1.17)	<b>1.49 (1.12, 1.85)**</b>	1.29 (1.02, 1.64)	1.05 (0.96, 1.17)	1.05 (0.93, 1.17)	1.11 (0.93, 1.31)	1.08 (0.98, 1.19)	<b>1.11 (1.03, 1.19)*</b>
Smoking								
Never	ref	ref	ref	ref	ref	ref	ref	ref
Former	1.06 (0.83, 1.36)	1.55 (0.64, 3.79)	1.13 (0.53, 2.36)	1.08 (0.81, 1.43)	1.09 (0.73, 1.63)	0.85 (0.57, 1.29)	—	1.07 (0.85, 1.35)
Current	0.91 (0.62, 1.32)	2.44 (0.74, 9.03)	0.78 (0.28, 2.16)	0.87 (0.53, 1.41)	1.03 (0.65, 1.63)	0.93 (0.31, 2.77)	—	0.89 (0.64, 1.24)
Alcohol, average number of drinks per week								
0	ref	ref	ref	ref	ref	ref	ref	—
1–7	<b>1.37 (1.12, 1.69)*</b>	3.41 (0.83, 13.88)	1.40 (0.64, 3.06)	<b>1.48 (1.15, 1.90)*</b>	0.90 (0.60, 1.35)	0.61 (0.32, 1.17)	1.48 (1.03, 2.13)	—
8–14	1.24 (0.91, 1.69)	0.82 (0.31, 2.12)	0.95 (0.41, 2.20)	1.29 (0.89, 1.86)	1.19 (0.68, 2.07)	0.74 (0.34, 1.59)	1.09 (0.67, 1.76)	—
>14	1.12 (0.90, 1.58)	1.08 (0.30, 3.85)	1.10 (0.43, 2.79)	1.27 (0.91, 1.76)	0.78 (0.47, 1.29)	0.61 (0.24, 1.55)	0.97 (0.61, 1.55)	—

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**Table 4.** Adjusted Associations With Extraoral Cancer Screening Exam (continued)

Characteristic	All sample, <sup>a</sup> RR (95% CI)	MA, <sup>b</sup> RR (95% CI)	OH, <sup>b</sup> RR (95% CI)	WNH, <sup>b</sup> RR (95% CI)	BNH, <sup>b</sup> RR (95% CI)	ANH, <sup>b</sup> RR (95% CI)	Smokers, <sup>c</sup> RR (95% CI)	Alcohol users, <sup>d</sup> RR (95% CI)
Health insurance								
Uninsured	<b>0.62 (0.45, 0.87)*</b>	1.04 (0.26, 4.16)	0.75 (0.18, 3.10)	0.54 (0.34, 0.86)	1.17 (0.62, 2.17)	0.28 (0.07, 1.04)	0.79 (0.51, 1.22)	<b>0.65 (0.50, 0.84)*</b>
Private	ref	ref	ref	ref	ref	ref	ref	ref
Medicare	0.88 (0.62, 1.27)	0.52 (0.08, 3.38)	0.84 (0.33, 2.11)	0.84 (0.53, 1.34)	1.61 (0.93, 2.79)	0.30 (0.89, 1.04)	1.04 (0.65, 1.65)	0.80 (0.54, 1.17)
Medicaid	0.82 (0.50, 1.34)	0.73 (0.06, 8.32)	1.90 (0.53, 6.85)	0.61 (0.33, 1.16)	1.44 (0.74, 2.78)	0.19 (0.03, 1.24)	0.77 (0.40, 1.49)	0.82 (0.54, 1.24)
Other	0.86 (0.54, 1.38)	0.79 (0.13, 4.77)	1.46 (0.37, 5.76)	0.74 (0.39, 1.37)	<b>1.85 (1.13, 3.03)*</b>	0.35 (0.09, 1.35)	0.91 (0.50, 1.62)	1.12 (0.65, 1.93)

Note: Boldface indicates statistical significance (\* $p < 0.01$ , \*\* $p < 0.001$ ).

<sup>a</sup>Adjusted for age, sex, race/ethnicity, PIR, education, smoking status, marital status, and insurance status.

<sup>b</sup>Adjusted for age, sex, PIR, education, smoking status, marital status, and insurance status.

<sup>c</sup>Current and former smokers; adjusted for age, sex, race/ethnicity, PIR, education, marital status, and insurance status.

<sup>d</sup>Those who reported any level of alcohol use in the past 12 months.

ANH, Asian, non-Hispanics; BNH, black, non-Hispanics; MA, Mexican Americans; OH, other Hispanics; PIR, poverty income ratio; WNH, white, non-Hispanics.

different groups have access. Selective access of less-educated, low-income, uninsured/publicly insured, and racial/ethnic minority patients to dental professionals who have limited time or training to provide OCS to their patients could have led to lower screening among these groups. Dental professionals who care for a disproportionately low-income or uninsured/publicly insured patient population also may need to move through patients more quickly owing to a lower level of reimbursement to maintain a financially viable practice. The existence of differential access, if shown, will be a significant public health issue because of its potential to perpetuate poor quality of care for underserved populations. An evaluation of these factors will require profiling of dental practices based on their patient population to understand its impact on services and outcomes. This will help in identification of the needs of specific dental practices and facilitate the development of measures to improve services and outcomes.

Disparities in OCS can explain the disparities in OC mortality and stage at diagnosis.<sup>30</sup> American Indians have poor survival when compared with whites.<sup>35</sup> An analysis of cancer trends in the U.S. showed that although black patients have a lower survival in general for every cancer type than whites, the largest differences in survival are seen for melanoma, cancers of the uterine corpus, and OCs.<sup>36</sup> These poor outcomes have largely been attributed to a later stage at presentation,<sup>35–37</sup> which could be a result of lack of OCS.<sup>10</sup> In addition, the population subgroups who report lower screening rates, namely low-income, less-educated, and racial/ethnic minority groups, are also more likely to have greater risk factors for OCs, such as tobacco use and alcohol consumption,<sup>38</sup> and to present with OCs.<sup>39</sup> Cancer screening programs have shown significant benefits in high-risk populations for reducing OC mortality.<sup>40–42</sup> These findings also might be relevant for physicians' practice, because some of the patients who are not screened at a dental practice might have an opportunity to be screened by their physicians. This further highlights the need for consistent education about OC and OCS among patients and providers.

**Limitations**

There are a few limitations of the study. First, the data are self-reported and thus might be subject to social, interpretation, and recall bias. However, these biases could have impacted the findings only if they were differentially distributed in the population. Moreover, in the absence of billing codes specific to OCS, its analysis will depend on self-report, observation, or self-documentation. This study highlights that separate reimbursement for OCS exams might not only facilitate OCS

but also can provide retrievable data for its evaluation. Second, individuals could be unaware that an oral exam was performed to identify cancer lesions or might falsely consider an exam to be for OCS. This also would impact the findings only if different groups were differentially aware or unaware. Differential awareness could be an important issue, as it is crucial to adequately inform the patient about each examination and its importance. It will be interesting to study if dental professionals are selective in their communication about the exam. Third, any information or educational session given during or outside of the screening visit that could have impacted an individual's response was not accounted for. Fourth, data for extraoral OCS exams were available only from 2011 to 2014. It is unlikely that data from an additional cycle could have changed the findings because lack of data availability from 2015 to 2016 cannot be attributed to any systematic cause. NHANES collects information on several topics in each data cycle and releases data on their website as and when the data are processed and ready for use. Finally, in a cross-sectional data set, OCS cannot be associated with OC.

## CONCLUSIONS

Recommendations are to perform OCS exams on every dental patient. However, despite having access to dental care, poor, less-educated, racial/ethnic minority, and uninsured dental patients are less likely than their counterparts to be screened. Given that these groups are also at a high risk of developing OCs because of their lifestyle-related risk factors,<sup>38,39</sup> the lower probability of dental professionals to screen these population subgroups is a missed opportunity for an early detection and improved outcomes of OCs. Concerted efforts should be undertaken to understand patients' and dental professionals' factors that impede equitable delivery of recommended OCS services. Efforts to both educate patients about requesting OCS in dental offices and adequately train dental professionals on culturally sensitive communications might be an effective means to increase OCS exams among minority high-risk populations.

## ACKNOWLEDGMENTS

The study was approved by the Partners Human Research Committee at the Partners Healthcare IRB (Protocol Number: 2016P001003).

Author contributions are as follows: AG was responsible for conceptualization, methodology and formal data analysis, data interpretation, writing the original draft/manuscript preparation, final approval of the version to be published, and agreement to be accountable for all aspects of the work. SS was responsible for co-conceptualization, critically reviewing and

editing the drafts/manuscript preparation, data interpretation, visualization/presentation of the data, supervision, final approval of the version to be published, and agreement to be accountable for all aspects of the work. RU was responsible for critically reviewing and editing the drafts/manuscript preparation, data interpretation, visualization/presentation of the data, supervision, final approval of the version to be published, and agreement to be accountable for all aspects of the work. RWB was responsible for co-conceptualization, critically reviewing and editing the drafts/manuscript preparation, data interpretation, visualization/presentation of the data, supervision, final approval of the version to be published, and agreement to be accountable for all aspects of the work. AV was responsible for co-conceptualization, critically reviewing and editing the drafts/manuscript preparation, visualization/presentation of the data, data interpretation, supervision, final approval of the version to be published, and agreement to be accountable for all aspects of the work.

Findings related to this manuscript have been selected for an oral presentation at the Academic Surgical Congress 2019 and were presented by the corresponding author on February 6, 2019.

No conflicts of interest were reported by the authors of this paper. No financial disclosures were reported by the authors of this paper.

## SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2019.04.026>.

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