Factors Associated With Oral Problems Among Adults With Spinal Cord Injury

Hon K. Yuen, PhD, OTR/L; Matthew S. Shotwell, MS; Kathryn M. Magruder, MPH, PhD; Elizabeth H. Slate, PhD; Carlos F. Salinas, DMD

Medical University of South Carolina, Charleston, South Carolina

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Abstract

Objective: To explore factors associated with self-reported current oral (tooth and gum) problems and oral pain in the past 12 months among adults with spinal cord injury.

Methods: An online oral health survey on the South Carolina Spinal Cord Injury Association website. Respondents were 192 adult residents of the US who identified themselves as having spinal cord injury at least 1 year before the survey date.

Results: Approximately 47% of respondents reported having oral problems at the time of the survey, and 42% reported experiencing oral pain in the 12 months before the survey date. Multiple predictor analyses (controlling for age, gender, income, and dental insurance) indicated that current oral problems were positively associated with dry mouth symptoms, financial barriers to dental care access, smoking, and paraplegia. Oral pain experienced in the past 12 months was positively associated with dry mouth symptoms, financial barriers to dental care access, minority race, and paraplegia.

Conclusions: Adults with spinal cord injury reported a high prevalence of oral problems and oral pain. Those with paraplegia were more likely to report problems than those with tetraplegia. Because dry mouth and smoking were significantly associated with these problems, patient education from both dental and medical providers should emphasize awareness of the side effects of xerostomia-causing medications, dry mouth management, and smoking cessation. Findings also indicate unmet needs for low-cost preventive and treatment dental services for this vulnerable population.

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INTRODUCTION

People with physical disabilities accompanied with socioeconomic disadvantage are more likely to experience untreated oral disease (1). In a pilot study, Stiefel et al (2) compared adults with spinal cord injury (SCI) to an employed adult population from the same region. Compared with that population group, adults with SCI

had more plaque, calculus, gingivitis, and decayed surfaces in addition to a higher percentage of untreated dental caries and deeper pocket depth (2).

People with SCI often take medications to reduce muscle spasms (eg, phenytoin and baclofen) (3) and to regulate neurogenic bladder problems (eg, bethanechol and oxybutynin) (4). Anticholinergic side effects associated with these medications can result in dry mouth (5), and mouth dryness was strongly associated with the number of potentially xerostomia-causing medications taken (6). Dry mouth has been shown to promote the development of dental plaque and increase the risk of developing dental caries (5,7). Adults who reported mouth dryness were more likely to have self-reported signs (loose teeth, bleeding gums, cavities, or broken teeth) and symptoms (toothache, sensitive teeth, chewing problems, bad breath, or unpleasant taste in mouth) of oral problems (6). Smoking can aggravate mouth dryness by reducing salivary flow (8).

Please address correspondence to Hon K. Yuen, PhD, OTR/L, Health Professions, Medical University of South Carolina, CHP Complex Bldg B, 151 Rutledge Avenue, Charleston, SC 29425; p: 843 792 3788; f: 843 792 0710 (e-mail: yuen@musc.edu).

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In addition, community-dwelling adults with SCI often face numerous major obstacles in obtaining regular dental care services, including high cost and physical barriers (2). For people with SCI, the combination of dry mouth from xerostomia-causing medications, barriers to dental care access, and poor oral hygiene performance may adversely affect their oral health and significantly increase the risk of oral health problems, such as dental caries and periodontal disease (2,9,10).

Oral health problems have considerable negative effects on quality of life. It is important to identify amendable factors that contribute to oral (tooth and gum) problems among people with SCI so that appropriate education and resources can be directed to improve oral health among this vulnerable population. The purpose of this study was to explore factors associated with (a) self-reported current oral (tooth or gum) problems and (b) oral pain in the past 12 months among adults with SCI.

METHODS

SCI Oral Health Survey

A survey of various oral health issues encountered by adults with SCI was conducted from mid-August of 2006 through mid-February 2007. The survey was posted on the South Carolina Spinal Cord Injury Association website (<http://www.scsca.org/>). Adults with SCI interested in completing the online survey could access it through the Internet. Informing individuals with SCI about the survey was mainly through word-of-mouth with assistance from the South Carolina Spinal Cord Injury Association and the South Carolina Traumatic Spinal Cord Injury Registry. Potential respondents could also request a paper copy of the survey (by phone or mail) if they did not have Internet access. The study was approved by the Institutional Review Board at the Medical University of South Carolina.

Outcome Variables

The 2 outcome variables were (a) current oral problems, defined as the presence of 1 or more oral (tooth or gum) problems or needs other than routine checking and dental cleaning at the time of the survey, and (b) oral pain in the past 12 months, defined as the presence of 1 or more adverse events in the 12 months before the survey date that were a direct result of pain in the teeth or gums. The outcome, current oral problems, was assessed from responses to the following question: "What kind of dental problems or needs do you have NOW?" Respondents who selected 1 or more of the specific dental or gum problems or needs requiring immediate attention (toothache, cavities, loose or wobbly tooth, need for tooth to be pulled out, need for fillings or other dental treatment, or gum problems [bleeding, swelling, pain]) were coded as positive for having current oral problems; otherwise, this outcome was coded as negative. The outcome, oral pain in the

past 12 months, was assessed from responses to the following question: "In the past 12 months, have you had any of the following incidents as a result of your teeth or gums hurting?" Respondents who selected 1 or more of these events ("used pain relief medication," "had disrupted sleeping," "went to see dentist," "missed work or school," "had disrupted eating," and "went to an emergency room") were coded as positive for having oral pain in the past 12 months; otherwise, this outcome was coded as negative. The rationale for using adverse events to define oral pain is that adverse events are generally memorable, thus improving recall accuracy.

The agreement between self-reported presence of oral problems and professional clinical assessment was generally good (11,12). Several population-based studies also indicated that self-reported oral problems provide reasonably valid and accurate estimates for oral disease (dental caries and periodontal disease) (11–17). For example, self-reported presences of caries and gingival bleeding or of a loose tooth were significantly associated with clinically determined dental and periodontal status, respectively (15,16,18).

In addition to the responses comprising the 2 outcome variables, the questionnaire contained items addressing the demographic and socioeconomic characteristics of the respondents, as well as their dental care visit patterns, barriers to dental care access, oral hygiene behaviors, dry mouth symptoms and management, smoking, and soda consumption habits, and whether they had been shown proper oral hygiene techniques since their SCI.

Demographic and socioeconomic characteristics included age, gender, race (white or other), marital status (married or unmarried), type of residence (rural or urban), education (education beyond high school or high school/less than high school), employment status (paid employment or not employed), annual household income (<\$25,000, \$25,000–\$49,999, or ≥\$50,000), dental insurance (private/public-funded or none), self-reported level of injury (paraplegia or tetraplegia), severity of injury, time since injury, indoor wheelchair use (yes or no), and complete upper limb movement (yes or no).

Dental visits and professional dental cleaning in the last year were coded as "yes" or "no." Barriers to dental care access included perception of cost barriers (respondents indicated that dental care "costs too much" or "dental office does not accept Medicaid"), physical barriers (respondents indicated they are "unable to get wheelchair into dental office or exam room" or "unable to transfer to dental chair"), and fear (respondents indicated they have "fear of the dentist" or they "do not trust the dentist"). Brushing habits were indicated by brushing at least twice daily or less often. Flossing habit was indicated by flossing at least once a day or less often. An explanatory variable was included indicating whether respondents were shown proper brushing and flossing

techniques by a dental professional since their SCI; positive was coded for those who answered “yes” and negative for those who indicated “no” or “do not remember.”

The presence of dry mouth symptoms was indicated by a positive response to 1 or more of the following 4 questions: “Do you sip liquids to aid in swallowing dry foods?”; “Does your mouth feel dry when eating a meal?”; “Do you have difficulties swallowing any foods?”; and “Does the amount of saliva in your mouth seem to be too little?” Whether respondents consumed sugar-containing products to relieve dry mouth (including sucking hard candy and drinking nondiet soda) was coded as “yes” or “no.”

Participant’s smoking was indicated by current/past smoking habits or designated as nonsmoking by “never smoked.” Soda consumption was quantified by the number of 12-ounce nondiet sodas consumed in a typical day and by the number of days a week the respondents drank nondiet sodas between meals.

Data Analysis

Continuous variables were summarized as mean $\pm$ SD and range or, for those variables that exhibited marked skewness, as median and range. Categorical variables were summarized by frequencies and percentages of responses for each category.

Responses from each of the questionnaire items were considered to be potential explanatory variables for the 2 outcomes (current oral problems and oral pain in the past 12 months). The pairwise association between each explanatory variable and each outcome was assessed via univariable logistic regression. Explanatory variables with associated *P* values <0.25 in the pairwise tests were considered in subsequent multiple predictor analysis (19). Confounding for each explanatory variable was assessed in the multiple predictor models by eliminating each variable sequentially and examining the relative change in the coefficients associated with the remaining variables (20,21). Explanatory variables, which upon elimination result in a $\geq 20\%$ change in at least 1 of the remaining coefficients, were considered to be confounders and were retained in subsequent modeling. It is important to retain confounders in the modeling to avoid misleading interpretation. To make inferences from the findings while controlling for demographic variables, age, gender, race, income, and dental insurance were retained in the final models for each outcome regardless of their *P* value in the multiple predictor models. For comparison, explanatory variables significantly related to 1 of the 2 outcomes were included in the final model for both outcomes. With the above exceptions, nonsignificant, nonconfounding explanatory variables were eliminated from the final models. All *P* values reported are 2-sided, and those with values <0.05 were interpreted as statistically significant. All analyses were performed using the statistical package R ver. 2.7.1 (22).

RESULTS

Respondents

A total of 207 respondents identifying themselves as having SCI and residing in the US completed the oral health survey. The majority (82.1%) completed the survey on line. Slightly more than half (51%) were from South Carolina, and the rest were from 26 other states. We excluded 3 respondents who indicated that they had completely recovered from their injury (ie, ASIA-E) and an additional 12 respondents who sustained a SCI within a year before completing the survey. Thus, a total of 192 eligible respondents were included in this study.

Of the 192 respondents, 142 reported that they sustained an injury at the cervical segment, indicating tetraplegia. The distribution of times since SCI was positively skewed, ranging from just more than 1 year to more than 55 years with a median of 9.01 years. The mean and SD of the respondents’ age was 43.9 ± 13.1 years (range: 19–83 y); the majority were male (59.9%) and white (77.6%). In terms of smoking habits, for exsmokers the average years of smoking was 17.6 (range: 2–45 y) and the average years of abstinence was 12.6 (range: 2 wk–40 y). General demographic and socioeconomic characteristics are shown in Table 1.

Oral Health Behaviors

The majority of respondents (87.5%) brushed their teeth daily, with 42.2% brushing at least twice a day; however, less than a quarter (22.9%) flossed their teeth at least once a day. About half (45.4%) of respondents reported using mouthwash at least once a day. Of those who used mouthwash, almost all (97.3%) used brands that contain alcohol. Dry mouth symptoms were reported by 59.9% of respondents. The percentage of respondents who reported visiting the dentist within the 12 months before the survey date was 65.5%, whereas only 54.6% reported having their teeth cleaned by dental professionals in that same period. The most common barrier to accessing dental care was high cost, reported by 40.1% of respondents, followed by physical barriers (22.9%) and dental fear (15.1%). Only 35.9% and 38.0% of respondents had been shown proper brushing and flossing techniques, respectively, by dental professionals since their SCI.

Oral Problems and Oral Pain

Ninety (46.9%) respondents indicated that they had oral problems that required dental treatment at the time of the survey. The frequencies of these responses for current oral problems are given in Table 2.

Oral Pain in the Past 12 Months. Adverse events resulting from oral pain experienced within the past 12 months were reported by 41.7% of respondents. The frequencies of these events are given in Table 3.

Factors Associated With Current Oral Problems. The single predictor models indicated that paraplegia, low

Table 1. Frequencies of Responses for Demographic and Socioeconomic Characteristics

	N	Count	Percentage
Level of injury (tetraplegia)	188	142	75.5
Self-report injury severity	187	—	—
No sensation or movement below injury level	—	56	29.2
Some sensation but no movement injury level	—	38	19.8
Some movement below injury level but cannot walk	—	46	24.0
Movement below injury level, which allows walking, sometimes with needed assistance	—	47	24.5
Indoor wheelchair users	192	149	77.6
Complete upper limb movement	192	65	33.9
Gender (male)	192	115	59.9
Race	192	—	—
White	—	149	77.6
African American	—	29	15.1
Hispanic	—	8	4.2
Other	—	6	3.1
Marital status (married)	192	88	45.8
Residence type (urban)	191	109	57.1
Education (beyond high school)	192	130	67.7
Employment (full- or part-time)	192	63	32.8
Annual household income	189	—	—
<\$25,000	—	78	41.3
\$25,000–\$49,999	—	47	24.9
≥\$50,000	—	64	33.8
Dental insurance	192	—	—
Private only	—	73	38.0
Public only (eg, Medicaid)	—	49	25.5
Public and private	—	4	2.1
None	—	77	40.1
Smoking habits	192	—	—
Regular (almost every day)	—	27	14.1
Every now and then (some days)	—	14	7.3
Previous smokers	—	39	20.3
Do not smoke	—	112	58.3

Counts not summing to 192 are the result of missing responses.

annual household income, financial barriers to dental care access, complaints of dry mouth, smoking, not having dental professionals show the proper toothbrushing techniques since the onset of SCI, not having professional dental cleaning in the last year, and dental fear were all significantly associated with current oral problems.

The odds of reporting current oral problems were 2.47 times higher in paraplegia vs tetraplegia respondents and increased by a factor of 1.66 for each \$25,000 decline in annual household income. The odds of reporting oral problems were 5.15 times greater for those who endorsed cost as a barrier to dental care

access, 2.46 times higher for those who reported symptoms of dry mouth vs those who did not, 2.09 times higher for those who were current or past smokers vs those who never smoked, 1.97 times greater for those who did not receive toothbrushing instruction by a dental professional since their SCI vs those who had, and 2.01 times greater for patients who had not had a professional dental cleaning within 12 months. Respondents who indicated the presence of dental fear as a barrier to dental care access had a 2.95-fold increase in the odds of reporting current oral problems compared with those who did not express this concern (Table 4).

Table 2. Frequencies of Responses for Current Oral (Tooth and Gum) Problems

Oral Problems	Count	Percentage
Need fillings or other dental treatment	64	33.3
Cavities	39	20.3
Tooth needs to be extracted	22	11.5
Gum problems (bleeding, swelling, pain)	20	10.4
Loose or wobbly tooth	15	7.8
Toothache	12	6.3

The sum of the counts indicates 172 current oral problems reported by 90 respondents.

Factors Associated With Oral Pain in the Past 12 Months. The single predictor analyses of oral pain in the past 12 months indicated paraplegia, minority status, financial barrier related to dental care access, complaints of dry mouth, taking sugar-containing products to relieve dry mouth (including sucking hard candy and drinking nondiet soda), and not having been shown proper oral hygiene (brushing and flossing) techniques since the SCI were all significantly associated with oral pain in the past 12 months.

Respondents with paraplegia experienced a 2.25-fold increase in the odds of experiencing oral pain in the past 12 months compared with respondents with tetraplegia. The odds of experiencing oral pain in the past 12 months increased by 2.10 for minority race (where 86% were African Americans or Hispanics) compared with whites. The odds of experiencing oral pain in the past 12 months were 2.93 times greater for those who expressed cost as a barrier to dental care access compared with those who did not mention this barrier, 2.10 times higher for those who complained of dry mouth vs those who did not, and 2.26 times higher for those who took sugar-containing products to relieve dry mouth vs those who did not. The odds of experiencing oral pain in the past 12 months were 2.11 and 2.20 times higher for those who were not shown proper brushing and flossing techniques, respectively (Table 5).

Multiple Predictor Analysis on Current Oral Problems and Oral Pain in the Past 12 Months. Level of injury (paraplegia or tetraplegia), financial barriers to dental care access, dry mouth, smoking, indoor wheelchair use, and whether respondents had been shown proper toothbrushing and flossing technique were included as explanatory variables in the final models for each outcome, controlling for race, age, gender, annual household income, and dental insurance. Results for these analyses are given in Tables 4 and 5.

Final Model for Current Oral Problems. Level of injury, financial barriers, dry mouth, and smoking were significant explanatory variables in the final model for reporting current oral problems. Respondents with

Table 3. Frequencies of Responses for Oral Pain in the Past 12 Months

Adverse Events	Count	Percentage
Pain medication used	43	22.4
Eating disrupted	38	19.8
Dentist visited	35	18.2
Sleep disrupted	17	8.8
Work or school missed	3	1.6
Emergency room visited	1	0.5

The sum of the counts indicates 137 oral pain experiences in the past 12 months reported by 80 respondents.

paraplegia had a 2.87-fold increase in the odds (adjusted odds ratio [OR] = 2.87; 95% CI = 1.21, 6.90; $P = 0.017$) of reporting current oral problems than respondents with tetraplegia. The odds of reporting current oral problems were 6.30 times (adjusted OR = 6.30; 95% CI = 2.82, 14.08; $P < 0.001$) greater for those who expressed cost as a barrier to dental care access compared with those who did not mention this barrier. The odds of reporting current oral problems were 3.09 times (adjusted OR = 3.09; 95% CI = 1.42, 6.68; $P = 0.004$) higher for those complained of dry mouth compared with those who did not, and 3.24 times greater (adjusted OR = 3.24; 95% CI = 1.52, 6.92; $P = 0.002$) for current or past smokers compared with those who never smoked.

Final Model for Oral Pain in the Past 12 Months. Level of injury, financial barrier, dry mouth, and race were significant explanatory variables in the final model for experiencing oral pain in the past 12 months. The odds of experiencing oral pain in the past 12 months were 2.32 (adjusted OR = 2.32; 95% CI = 1.05, 5.13; $P = 0.038$) times greater for respondents with paraplegia compared with respondents with tetraplegia. The odds of experiencing oral pain in the past 12 months were 2.85 times (adjusted OR = 2.85; 95% CI = 1.36, 5.95; $P = 0.005$) for those who expressed cost as a barrier to dental care access compared with those who did not mention this barrier, 2.22 times (adjusted OR = 2.22; 95% CI = 1.08, 4.59; $P = 0.031$) higher for those who complained of dry mouth than those who did not, and 2.57 (adjusted OR = 2.57; 95% CI = 1.06, 6.25; $P = 0.037$) times greater for minorities (African Americans and Hispanics) compared with whites.

DISCUSSION

Results indicated that about half of all respondents with SCI in this study reported current oral problems and oral pain in the past 12 months. This is considerably higher than previously published reports of 7% to 32% of the general population experiencing tooth pain (23,24). The 3 common significant explanatory variables in the final multiple predictor models for both outcomes were level of injury, financial barriers to dental care access, and dry

Table 4. Single and Multiple Predictor Logistic Regression Analyses for Self-Reported Current Oral (Tooth and Gum) Problems

Explanatory Variables	Single Predictor Analysis			Multiple Predictor Analysis		
	Odds Ratio	95% CI	P Value	Adjusted Odds Ratio	95% CI	P Value
Level of injury (paraplegia)	2.469	(1.244, 4.902)	0.010	2.874	(1.205, 6.897)	0.017
Race (minority)	1.408	(0.713, 2.778)	0.325	1.057	(0.410, 2.725)	0.909
Age	1.017	(0.995, 1.040)	0.125	1.016	(0.988, 1.044)	0.264
Gender (male)	1.675	(0.936, 2.994)	0.082	1.272	(0.609, 2.660)	0.521
Dental insurance (none)	1.405	(0.787, 2.509)	0.250	1.327	(0.598, 2.942)	0.487
Low household income	1.661	(1.179, 2.339)	0.004	1.274	(0.799, 2.033)	0.308
Financial barrier to dental care	5.152	(2.751, 9.648)	<0.001	6.303	(2.822, 14.078)	<0.001
Dry mouth	2.462	(1.353, 4.479)	0.003	3.085	(1.423, 6.684)	0.004
Smoking	2.091	(1.167, 3.747)	0.013	3.239	(1.516, 6.920)	0.002
Indoor wheelchair use	1.795	(0.903, 3.568)	0.095	1.840	(0.764, 4.431)	0.174
Not shown brushing techniques	1.972	(1.077, 3.613)	0.028	2.101	(0.986, 4.484)	0.054
Fear barrier to dental care	2.952	(1.267, 6.877)	0.012	—	—	—
No dental cleaning last year	2.013	(1.130, 3.585)	0.018	—	—	—

mouth symptoms. Additional significant explanatory variables were smoking (for current oral problems) and race (for oral pain in the past 12 months).

These results are consistent with previous literature investigating factors associated with self-reported oral problems in the general population. Self-reported oral problems have been shown to be significantly related to dry mouth (6,12) and are more likely to be reported by racial minorities (14,15,17,25), smokers (8,14,17), low-household income groups (23,24), and those who are not financially comfortable (26). In the present study, financial barriers to dental care access and low annual

household income are both significantly associated with the 2 outcomes in the univariate analyses; however, due to the high level of correlation between these 2 explanatory variables, only financial barriers to dental care access was significant in the final multiple predictor model. This indicates that financial barriers have more explanatory power than household income.

The most surprising explanatory variable for the 2 outcomes was the level of injury, for which respondents with paraplegia were more likely to report oral problems than those with tetraplegia. Because adults with tetraplegia have been reported to have significantly more

Table 5. Single and Multiple Predictor Logistic Regression Analyses for Self-Reported Oral Pain Experienced in the Past 12 Months

Explanatory Variables	Single Predictor Analysis			Multiple Predictor Analysis		
	Odds Ratio	95% CI	P Value	Adjusted Odds Ratio	95% CI	P Value
Level of injury (paraplegia)	2.252	(1.145, 4.425)	0.019	2.315	(1.047, 5.128)	0.038
Race (minority)	2.096	(1.055, 4.167)	0.035	2.571	(1.059, 6.250)	0.037
Age	1.006	(0.984, 1.028)	0.619	0.997	(0.970, 1.024)	0.820
Gender (male)	1.695	(0.943, 3.040)	0.078	1.429	(0.711, 2.874)	0.316
Dental insurance (none)	1.417	(0.790, 2.542)	0.243	0.736	(0.350, 1.548)	0.419
Low household income	1.390	(1.954, 0.989)	0.058	0.887	(0.560, 1.404)	0.608
Financial barrier to dental care	2.926	(1.607, 5.327)	<0.001	2.848	(1.364, 5.947)	0.005
Dry mouth	2.096	(1.144, 3.839)	0.017	2.224	(1.077, 4.593)	0.031
Smoking	1.647	(0.919, 2.951)	0.093	1.920	(0.959, 3.845)	0.065
Indoor wheelchair use	1.856	(0.936, 3.680)	0.076	2.143	(0.949, 4.840)	0.067
Not shown brushing techniques	2.107	(1.130, 3.929)	0.019	2.041	(0.984, 4.237)	0.055
Not shown flossing techniques	2.204	(1.191, 4.08)	0.012	—	—	—
Candy/soda for dry mouth relief	2.262	(1.241, 4.124)	0.008	—	—	—

bleeding gum sites than those with paraplegia (10), it is expected that respondents with tetraplegia in this sample would be more likely to report oral problems and oral pain; however, results of the analyses in the present study indicated the opposite. The direction of the association between the outcomes and level of injury remained unchanged even when respondents with tetraplegia who were dependent on others for oral hygiene (ie, toothbrushing) were removed from the analysis. Hence, dependence on others for oral hygiene does not account for the lower prevalence of both outcomes among respondents with tetraplegia. Furthermore, the proportion of respondents with tetraplegia and paraplegia who had a professional dental cleaning in the year before completing the survey was similar (54.5% vs 56.3%, $P = 0.90$). We conclude that this phenomenon is likely due to attributes not investigated in this study.

Limitations

Even self-reported oral problems are shown to be a reasonable proxy for clinical diagnosis (11–17). A more accurate picture of these problems will only be determined by an oral examination and cross-check documentation of the reported adverse events through dental and medical records indicating that the respondents visited a dentist or an emergency room as a result of oral pain.

We acknowledge that the sample in this study is a convenience sample that may or may not represent the SCI population. Nevertheless, it should be noted that findings in the present study (that adults with SCI were as likely to have had an annual dental visit in the past year as the general population) are similar to those reported in the Johnston et al study (27) (unpublished data/manuscript). Confirmation of results reported in the present study should come with a population study using the National Spinal Cord Injury Statistical Center database.

Implications

Dry mouth and smoking are well-known contributors to oral problems (5,6,8,12,14,17). It is important for both dental and medical health professionals to continue their efforts to educate patients with SCI about the side effects of the xerostomia-causing medications that they take, proper dry mouth management, and the fact that smoking aggravates mouth dryness by reducing salivary flow. On a related note, respondents with SCI who used mouthwash tended to use brands that contain alcohol, which has been shown to increase mouth dryness. With more brands of mouth rinse that contain no alcohol on the market (eg, Crest PRO-HEALTH), it is important to educate patients with SCI to select brands of mouth rinse that do not contain alcohol. Finally, low-cost preventive and dental treatment service for people with SCI remains an important unmet need.

An interesting amendable explanatory variable that is marginally significant in the 2 final models is whether respondents had been shown proper brushing techniques by a dental professional since their SCI. Respondents who reported having this instruction were less likely to report oral problems.

CONCLUSIONS

Adults with spinal cord injury reported a high prevalence of oral problems and oral pain. Because dry mouth and smoking were significantly associated with these problems, patient education from both dental and medical providers should emphasize awareness of the side effects of xerostomia-causing medications, dry mouth management, and smoking cessation as well as proper oral hygiene. Findings also indicate unmet needs for low-cost preventive and treatment dental services for this vulnerable population.

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