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Oral health of substance-dependent individuals: Impact of specific substances

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Abstract

Little is known about how different types of substances affect oral health. Our objective was to examine the respective effects of alcohol, stimulants, opioids, and marijuana on oral health in substance-dependent persons. Using self-reported data from 563 substance-dependent individuals, we found that most reported unsatisfactory oral health, with their most recent dental visit more than 1 year ago. In multivariable logistic regressions, none of the substance types were significantly associated with oral health status. However, opioid use was significantly related to a worse overall oral health rating compared to 1 year ago. These findings highlight the poor oral health of individuals with substance dependence and the need to address declining oral health among opioid users. General health and specialty addiction care providers should be aware of oral health problems among these patients. In addition, engagement into addiction and medical care may be facilitated by addressing oral health concerns.

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Keywords

Oral health; Substance dependence; Dental care

1. Introduction

Poor oral health is a common problem among individuals with substance dependence, yet this topic has been largely neglected in the addiction literature (Reece, 2009). Individuals with heavy substance use are at increased risk for poor oral health for a variety of reasons, including limited access to dental care (Johnson, Hearn, & Barker, 2008; Khocht, Schleifer, Janal, & Keller, 2009; Sheridan, Aggleton, & Carson, 2001; ter Horst, Molendijk, Brouwer, & Verhey, 1996), poor dietary (Laslett, Dietze, & Dwyer, 2008; Morio, Marshall, Qian, &Morgan, 2008; Titsas and Ferguson, 2002) and oral hygiene habits (Barbadoro, Lucrezi, Prospero, & Annino, 2008; Friedlander, Marder, Pisegna, & Yagiela, 2003; Morio et al., 2008), negative attitudes about oral health and health care (Robinson, Acquah, & Gibson, 2005), and direct physical effects of the substance on oral health. There are several mechanisms by which drugs can directly affect oral health, including increased xerostomia (dry mouth) due to hyposalivation (lack of salivary flow), poor diet and self-care leading to higher rates of dental caries, enamel erosion, and periodontal disease (Friedlander et al., 2003; Hamamoto and Rhodus, 2009; Morio et al., 2008; Versteeg, Slot, van der Velden, & van der Weijden, 2008).

Prior research suggests that individuals who abuse methamphetamines (Curtis, 2006; Donaldson and Goodchild, 2006; Hamamoto and Rhodus, 2009; Morio et al., 2008; Shetty et al., 2010), alcohol (Araujo, Dermen, Connors, & Ciancio, 2004; Hornecker, Muuss, Ehrenreich, & Mausberg, 2003; Khocht et al., 2009; Manarte, Manso, Souza, Frias-Bulhosa, & Gago, 2009), opioids (Sheedy, 1996; Steinmiller and Greenwald, 2007), marijuana (Versteeg et al., 2008), and cocaine (Brand, Gonggrijp, & Blanksma, 2008) are at increased risk of poor oral health outcomes, including enamel erosion and caries. It is not clear, however, whether these consequences are substance specific or due to substance dependence in general. Suboptimal oral health and periodontal disease are associated with health consequences localized to dental issues, such as tooth loss (Martin, Page, Loeb, & Levi, 2010), and more pervasive physical health problems (Slots, 2003), including cerebrovascular disease (Wu et al., 2000), low birth weight (Cruz et al., 2009; Moliterno, Monteiro, Figueredo, & Fischer, 2005), pulmonary infection (Mojon, 2002), diabetes (Demmer, Jacobs, & Desvarieux, 2008), and potentially cardiovascular disease (Humphrey, Fu, Buckley, Freeman, & Helfand, 2008). Given the deleterious impact of poor oral health on both local and systemic health outcomes, it is critical to identify populations at increased risk in an effort to develop tailored interventions to improve overall health in this population.

Despite its prevalence and consequences, there have been few studies that compare and contrast the oral health of patients who use different substances. Most studies that have examined oral health among substance users are cross-sectional or case studies and have assessed only one type of substance (Araujo et al., 2004; Hornecker et al., 2003; Khocht et al., 2009; Manarte et al., 2009; Morio et al., 2008; Versteeg et al., 2008; Shetty et al., 2010) and include small samples (Araujo et al., 2004; Johnson et al., 2008; Khocht et al., 2009; Morio et al., 2008; Robinson et al., 2005; Sheedy, 1996). Many studies and reviews that have addressed the issue of substance use and oral health were conducted internationally, with little work focused in the United States, where the stigma of substance use and perceptions of and access to treatment for oral health may be different (Barbadoro et al., 2008; Blanksma and Brand, 2004; Cho, Hirsch, & Johnstone, 2005; Johnson et al., 2008;

Laslett et al., 2008; Molendijk, Ter Horst, Kasbergen, Truin, & Mulder, 1996; Pilinova, Krutina, Salandova & Pilin, 2003; Reece, 2007; Robinson et al., 2005; Sheridan et al., 2001; ter Horst et al., 1996). Understanding how specific types of substances affect oral health can potentially help target interventions to certain groups at risk. Thus, the purpose of this study is to examine whether substance use, including alcohol, stimulants, opioids, and marijuana, is associated with oral health status among people with substance dependence.

2. Materials and methods

2.1. Design

We analyzed data on self-rated oral health and substance use collected prospectively from participants enrolled in a randomized trial testing the effectiveness of chronic care management in the primary care setting in Boston from September 2006 to September 2008. This study was approved by the Boston University Medical Campus Institutional Review Board. All subjects provided informed consent, and procedures were followed in accordance with the Helsinki Declaration of 1975. A certificate of confidentiality was obtained from the National Institute on Alcohol Abuse and Alcoholism to further protect participants' privacy. We hypothesized that different types of substances would differentially affect oral health.

2.2. Sample

The sample included 563 men and women who reported using a variety of substances and had enrolled in the Addiction Health Evaluation and Disease Management study. All subjects had current alcohol and/or drug dependence by *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* criteria (American Psychiatric Association, 2000) assessed using the Composite International Diagnostic Interview Short form (Gigantesco and Morosini, 2008) and were willing to establish or continue primary medical care at the study location. Participants were included if they reported past 30-day drug use or heavy alcohol use (defined as ≥4 standard drinks for women, ≥5 for men at least twice; or >14 drinks per week for women, >21 drinks per week for men, in an average week in the past month). Approximately 74% of the subjects were recruited from a detoxification center, 9% from ambulatory care/outpatient settings, 1% from the hospital emergency department or inpatient setting, and 16% from other sources. Subjects were at least 18 years of age, spoke English or Spanish, and were without indication of cognitive impairment at screening (assessed using the Mini Mental State Examination score greater than 20; Klein et al., 1985). For this analysis, data were taken from an interview conducted at study entry prior to randomization; thus, any intervention effects would not impact survey responses.

2.3. Measures

2.3.1. Independent variables: Types of substances used—The four main independent variables of interest represented use of a particular type of substance: heavy alcohol (yes/no), stimulants (yes/no), opioids (yes/no), and marijuana (yes/no). All subjects in this study met criteria for substance dependence; however, for this analysis, we are analyzing different types of substance use. Thus, the term *substance use* is used to refer to these variables. Heavy alcohol use was assessed using the timeline follow-back measure and defined as drinking five or more drinks at least 1 day in the past 30 days (if male) or four or more drinks at least 1 day in the past 30 days (if female; National Institute on Alcohol Abuse and Alcoholism, 2005). Other drug use was assessed using the Addiction Severity Index (McLellan, Luborsky, Woody, & O'Brien, 1980). Stimulant use was defined as using cocaine or amphetamines at least 1 day in the past 30 days. Individuals who used heroin, methadone, or other opioid analgesics, either without a doctor's prescription, in larger amounts than prescribed, or for a longer period than prescribed, at least 1 day in the past 30

days were considered opioid users. Marijuana use was defined as using marijuana or cannabis at least 1 day in the past 30 days.

2.3.2. Dependent variables: Oral health indicators—Our primary outcome was self-reported oral health status ("How would you describe the health of your teeth and gums?"; Jones et al., 2004). Subjects rated this item on a 5-point Likert scale, which was then dichotomized into *satisfactory* oral health, defined as "excellent," "very good," or "good," versus *unsatisfactory*, defined as "fair" or "poor" (Cunha-Cruz, Hujoel, & Kressin, 2007; Jones, Spiro, Miller, Garcia, & Kressin, 2002). Four secondary self-reported outcomes related to oral health were also evaluated. Health of teeth and gums compared to 1 year ago was dichotomized as *worse*, defined as "somewhat" or "much" worse, versus *the same*, "somewhat" or "much" better. Tooth or gum pain in the past 3 months was dichotomized as *pain* ("some," "quite a bit," or "a great deal") versus *no pain* ("little" or "none"). The time since last dentist visit was dichotomized as *recent* (<1 year ago) versus *distant* (≥1 year ago, never been to the dentist, or "don't know"). The number of permanent teeth removed because of tooth decay, gum disease, or infection was dichotomized as 0–5 versus 6 or more (Kapp, Boren, Yun, & LeMaster, 2007) The rationale for this dichotomy was that individuals could have had all four wisdom teeth or bicuspids extracted for orthodontic treatment and still have excellent oral health.

2.4. Covariates

The analyses controlled for sociodemographic and other variables that could affect oral health, including age, gender, education, being a current smoker, race/ethnicity, health insurance, and income. Health status was assessed using one item of a general rating of health on a 5-point Likert scale ranging from "excellent" to "poor", analyzed as a continuous variable (Ware, Kosinski, & Keller, 1996). In addition, oral health can also be influenced by lifestyle, including dietary and hygiene habits. Individuals in prison (Walsh, Tickle, Milsom, Buchanan, & Zoitopoulos, 2008) or who have experienced homelessness (De Palma and Nordenram, 2005; Gibson et al., 2003) may be at an increased risk for worse oral health due to poorer lifestyle habits and access to care. Thus, we included covariates of ever spending time in prison and recent homelessness, the latter defined as spending at least one night in a shelter or on the street in the last 3 months. Polysubstance use was also included and defined as using two or more of the above substances (heavy alcohol, stimulants, opioids, or marijuana) in the last 30 days.

2.5. Statistical analyses

Descriptive statistics were used to assess the bivariate relationship between subject characteristics and the primary outcome of unsatisfactory oral health. Two sample *t* tests and chi-square tests were used as appropriate to assess the bivariate associations. We evaluated the association between the types of substances used and each oral health outcome using separate logistic regression models. The multivariable logistic regression models were fit to evaluate the associations between types of substances used and worse oral health outcomes after adjustment for sociodemographic characteristics, health status, and lifestyle variables. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) are reported. To minimize the potential for collinearity, we assessed correlation between pairs of independent variables and covariates to identify pairs of variables that were correlated (i.e., $r > .50$). Polysubstance use was moderately correlated with stimulant use ($r = .66$). Polysubstance use was expected to be an important factor and potential confounder; therefore, we fit adjusted models with and without this covariate. Adjustment for polysubstance use attenuated the odds ratios for the main independent variables with oral health status. Thus, we present results controlling for polysubstance use as the final models. All analyses were conducted using two-sided tests

and a significance level of .05. Analyses were performed using SAS software (version 9.1; SAS Institute, Cary, NC).

3. Results

The majority of our sample was male (73%), currently smoking (88%), less than 50 years of age (88%; mean age = 38), with an annual income less than $50,000 (74%), had at least a high school education (76%), and had some form of health insurance (79%; Table 1). Almost half were White (47%), 32% Black, 13% Hispanic, and 8% other racial/ethnic background. Most were incarcerated at least once during their lives (78%), and many noted homelessness in the past 3 months (59%). Most reported heavy alcohol (78%), stimulant use (68%), opioid use (67%), and polysubstance use (81%). About half used marijuana in the last month (49%).

Overall, the majority of the sample reported unsatisfactory oral health (60%), with the most recent dental visit being more than 1 year ago or not able to recall (52%; Table 2). However, most reported the same or better oral health compared with 1 year ago (64%), little or no tooth/gum pain (63%), and having less than six teeth removed (71%).

3.1. Primary outcome: Oral health status

In unadjusted analyses, there were no significant associations between heavy alcohol use, stimulant use, opioid use, or marijuana use and unsatisfactory self-rated oral health. The findings were similar in adjusted analyses, where those with heavy alcohol use (AOR = 1.31, 95% CI = 0.79–2.15) and opioid use (AOR = 1.09, 95% CI = 0.66–1.79) had nonsignificant higher odds of unsatisfactory self-reported oral health; those with stimulant use (AOR = 0.85, 95% CI = 0.49–1.47) and marijuana use (AOR = 0.69, 95% CI = 0.45–1.06) had nonsignificant lower odds of unsatisfactory oral health (Table 3). In multivariable models, individuals who were older (AOR = 2.86, 95% CI = 1.41–5.80), currently smoking (AOR = 1.99, 95% CI = 1.13–3.50), and had a worse overall health status rating (AOR = 1.66, 95% CI = 1.37–2.01) had significantly higher odds of unsatisfactory oral health status (not shown).

3.2. Secondary outcomes

In adjusted analyses, opioid use was the only substance significantly related to a worse oral health rating compared with 1 year ago (AOR = 1.72, CI = 1.04–2.82; Table 3). None of the substance types were significantly associated with tooth/gum pain, time since last dental visit, or number of teeth removed. Overall, in adjusted analyses across secondary outcomes, marijuana use was associated with lower odds of worse oral health outcomes, although none of these associations were statistically significant.

4. Discussion

Overall, most of these individuals with substance dependence reported unsatisfactory oral health status, consistent with previous literature (Araujo et al., 2004). Contrary to our hypothesis, we did not detect an association between type of substance and self-reported oral health status. Of note, however, is that the reference group for each comparison is people with substance dependence who do not use the particular substance of interest (e.g., those with heavy alcohol use vs. those without heavy alcohol use but who use other substances), and thus, our findings should not be interpreted or generalized to represent the impact of a particular substance compared with no other substance use. Our results did reveal that opioid use is associated with worse self-rated oral health compared with 1 year ago. This is consistent with research that has found an association between opiate use and poor oral

health (Nathwani and Gallagher, 2008; Reece, 2007; Sheedy, 1996; Titsas and Ferguson, 2002). The association could be due to direct effects of opioids, or it could be that people with worsening oral health use opioids for relief (although this seems less likely given the absence of an association between opioid use and dental pain). Of note, however, is that opioid use is reported for the previous 30 days, and worse oral health is compared with 1 year ago. Subjects may be disappointed in their continued substance use, which may have affected their reports of worsening oral health status.

The association between use of methamphetamines or cocaine and poor oral health is well established in the literature (Brand et al., 2008; Curtis, 2006; Donaldson and Goodchild, 2006; Hamamoto and Rhodus, 2009; Shetty et al., 2010). Similarly, research indicates there is an association between alcohol dependence or marijuana use and poor oral health (Araujo et al., 2004; Hornecker et al., 2003; Khocht et al., 2009; Manarte et al., 2009; Versteeg et al., 2008). These findings from other studies are in contrast to ours. One possibility regarding stimulants is that although the prevalence of cocaine use was substantial in our sample, the prevalence of methamphetamine use was not. If more effects on oral health would be seen from the latter, then that could explain the absence of effect. However, one would have expected effects from cocaine itself. Another possible explanation for different findings is that most of the prior studies relied on oral examination to evaluate oral health outcomes. Our findings, that no individual substance type was related to overall oral health status, may be a function of individual subjectivity in the assessment of their oral health. Although methamphetamine use is associated with poor oral health compared with no methamphetamine use, it may not be associated with poor oral health more than other substances in people with dependence. Similarly, given the large percentage of polysubstance use in our sample, we may not have been able to disentangle the effects of specific substances on oral health.

Twenty-nine percent of our sample had six or more teeth removed. This is substantially more than the 8.5% of adults in the general population who have had six or more teeth removed, according to the Behavioral Risk Factor Surveillance Survey data from 2004 (Kapp et al., 2007). This finding confirms other research documenting worse oral health status among substance-dependent populations (Reece, 2009).

Although not the focus of this analysis, we noted that some covariates behaved as we expected, supporting their inclusion in the adjusted models. The association between smoking and worse oral health is not surprising, given the previous literature confirming their correlation (Friedlander et al., 2003; Morio et al., 2008). The persistent association between lower self-rated health status and oral health across several models suggests that oral health may influence physical health or vice versa. A longitudinal study examining health status over time could better determine that causal pathway. Future research should also compare self-reported oral health of this population to the general population to understand the extent to which oral health is worse among individuals with substance dependence.

These findings should be interpreted within the limitations of our analysis. All of our oral health outcomes are self-reported and thus subject to recall and other potential biases; we did not conduct a clinical dental health examination. We believe there is value in understanding patients' perceptions of their oral health, given that subjective assessment can affect health behaviors (Baker, 2009; Kneckt, Syrjala, & Knuuttila, 1999). For number of teeth removed, which can be considered a less subjective measure, there is evidence that self-report is highly correlated with the number of teeth found missing on clinical examination and thus can be considered reasonably reliable (Pitiphat, Garcia, Douglass, & Joshipura, 2002). We included a measure of recent homelessness in our analysis; however,

an estimate of long-term homelessness may have been more appropriate considering its chronic impact on lifestyle, dietary habits, and oral health care. Our definition of substance use was defined within the last 30 days, which may not entirely capture the effects on oral health, given that long-term exposure of a particular substance would have more of an impact on these outcomes. Given our reference group in adjusted analyses, we are not able to assess the independent effects of a particular substance compared with people who did not use any substances. Instead, our results indicate the effects of a substance on oral health, above and beyond the effects of other substances. Finally, we do not have data to compare to non-substance-using populations, and thus, it is difficult to tease out the effects of substance use and other sociodemographic characteristics. We attempted to do so in our adjusted model, controlling for age, education, gender, race/ethnicity, smoking, health insurance, income, health status, lifetime incarceration, homelessness, and polysubstance use.

Despite these limitations, this study is among the first to assess the differential effects of varying types of substance use on self-rated oral health outcomes. Our findings suggest that addiction treatment providers, as well as medical and dental clinicians, should consider dental and addiction problems as associated comorbidities, requiring the development of treatment plans that address both substance use and potential oral health problems. These results suggest that type of substance had little effect on oral health outcomes. However, the overall poor rating of oral health in our sample indicates that the health of teeth and gums is a significant issue among individuals who use alcohol and/or drugs, in general. Thus, interventions for poor oral health could be tailored toward this population.

Despite the association between substance use and oral health and national recommendations for improving oral health among such vulnerable populations (Department of Health and Human Services, 2000), few interventions have been targeted to individuals with substance dependence. One intervention aimed at improving knowledge, attitudes, and behavior of individuals with alcohol dependence found that the intervention group who attended a lecture had significant improvement in oral health behaviors after 1 year, including frequency of tooth brushing (Barbadoro et al., 2008). Although conducted in Italy, this study has implications for rehabilitation programs in the United States, where such educational workshops can be incorporated into treatment. Clinicians should pay particular attention to oral health among opioid users. Given our findings, and the correlation between oral and general health status, oral health warrants increased attention and public health efforts among substance users. In addition, general health and specialty addiction care providers should be aware of oral health problems among patients with substance dependence. Finally, engagement into addiction and medical care, often a challenge in this population, may be facilitated by addressing oral health concerns.

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References

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. Washington, DC: American Psychiatric Association; 2000.

Araujo MW, Dermen K, Connors G, Ciancio S. Oral and dental health among inpatients in treatment for alcohol use disorders: A pilot study. Journal of the International Academy of Periodontology. 2004; 6:125–130. [PubMed: 15553979]

Baker SR. Applying Andersen's behavioural model to oral health: What are the contextual factors shaping perceived oral health outcomes? Community Dentistry and Oral Epidemiology. 2009; 37:485–494. [PubMed: 19845712]

Barbadoro P, Lucrezi D, Prospero E, Annino I. Improvement of knowledge, attitude, and behavior about oral health in a population of alcohol addicted persons. Alcohol and Alcoholism. 2008; 43:347–350. [PubMed: 18326549]

Blanksma CJ, Brand HS. Effects of cocaine use on oral health and implications for dental treatment. Nederlands Tijdschrift Voor Tandheelkunde. 2004; 111:486–489. [PubMed: 15646684]

Brand HS, Gonggrijp S, Blanksma CJ. Cocaine and oral health. British Dental Journal. 2008; 204:365–369. [PubMed: 18408681]

Cho CM, Hirsch R, Johnstone S. General and oral health implications of cannabis use. Australian Dental Journal. 2005; 50:70–74. [PubMed: 16050084]

Cruz SS, Costa Mda C, Gomes-Filho IS, et al. Contribution of periodontal disease in pregnant women as a risk factor for low birth weight. Community Dentistry and Oral Epidemiology. 2009; 37:527–533. [PubMed: 19694773]

Cunha-Cruz J, Hujoel PP, Kressin NR. Oral health-related quality of life of periodontal patients. Journal of Periodontal Research. 2007; 42:169–176. [PubMed: 17305876]

Curtis EK. Meth mouth: A review of methamphetamine abuse and its oral manifestations. General Dentistry. 2006; 54:125–129. [quiz 130]. [PubMed: 16689071]

Demmer RT, Jacobs DR Jr, Desvarieux M. Periodontal disease and incident type 2 diabetes: Results from the First National Health and Nutrition Examination Survey and its epidemiologic follow-up study. Diabetes Care. 2008; 31:1373–1379. [PubMed: 18390797]

De Palma P, Nordenram G. The perceptions of homeless people in Stockholm concerning oral health and consequences of dental treatment: A qualitative study. Special Care in Dentistry. 2005; 25:289–295. [PubMed: 16463601]

Department of Health and Human Services. Oral health in America: A report of the surgeon general. Rockville, MD, U.S: Department of Health and Human Service, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000.

Donaldson M, Goodchild JH. Oral health of the methamphetamine abuser. American Journal of Health-System Pharmacy. 2006; 63:2078–2082. [PubMed: 17057044]

Friedlander AH, Marder SR, Pisegna JR, Yagiela JA. Alcohol abuse and dependence: Psychopathology, medical management and dental implications. Journal of the American Dental Association. 2003; 134:731–740. [PubMed: 12839410]

Gibson G, Rosenheck R, Tullner JB, et al. A national survey of the oral health status of homeless veterans. Journal of Public Health Dentistry. 2003; 63:30–37. [PubMed: 12597583]

Gigantesco A, Morosini P. Development, reliability and factor analysis of a self-administered questionnaire which originates from the World Health Organization's Composite International Diagnostic Interview—Short Form (CIDI-SF) for assessing mental disorders. Clinical Practice in Epidemiology and Mental Health. 2008; 4:8.

Hamamoto DT, Rhodus NL. Methamphetamine abuse and dentistry. Oral Diseases. 2009; 15:27–37. [PubMed: 18992021]

Hornecker E, Muuss T, Ehrenreich H, Mausberg RF. A pilot study on the oral conditions of severely alcohol addicted persons. Journal of Contemporary Dental Practice. 2003; 4:51–59. [PubMed: 12761589]

Humphrey LL, Fu R, Buckley DI, Freeman M, Helfand M. Periodontal disease and coronary heart disease incidence: A systematic review and meta-analysis. Journal of General Internal Medicine. 2008; 23:2079–2086. [PubMed: 18807098]

Johnson D, Hearn A, Barker D. A pilot survey of dental health in a group of drug and alcohol abusers. European Journal of Prosthodontics and Restorative Dentistry. 2008; 16:181–184. [PubMed: 19177730]

Jones JA, Spiro A III, Miller DR, Garcia RI, Kressin NR. Need for dental care in older veterans: Assessment of patient-based measures. Journal of the American Geriatrics Society. 2002; 50:163–168. [PubMed: 12028262]

Jones J, Kressin N, Miller D, et al. Comparison of patient-based oral health outcome measures. Quality of Life Research. 2004; 13:975–985. [PubMed: 15233511]

Kapp JM, Boren SA, Yun S, LeMaster J. Diabetes and tooth loss in a national sample of dentate adults reporting annual dental visits. Preventing Chronic Disease. 2007; 4:A59. [PubMed: 17572963]

Khocht A, Schleifer SJ, Janal MN, Keller S. Dental care and oral disease in alcohol-dependent persons. Journal of Substance Abuse Treatment. 2009; 37:214–218. [PubMed: 19150205]

Klein LE, Roca RP, McArthur J, et al. Diagnosing dementia. Univariate and multivariate analyses of the mental status examination. Journal of the American Geriatrics Society. 1985; 33:483–488. [PubMed: 4008847]

Kneckt MC, Syrjala AM, Knuuttila ML. Locus of control beliefs predicting oral and diabetes health behavior and health status. Acta Odontologica Scandinavica. 1999; 57:127–131. [PubMed: 10480277]

Laslett AM, Dietze P, Dwyer R. The oral health of street-recruited injecting drug users: Prevalence and correlates of problems. Addiction. 2008; 103:1821–1825. [PubMed: 19032532]

Manarte P, Manso MC, Souza D, Frias-Bulhosa J, Gago S. Dental erosion in alcoholic patients under addiction rehabilitation therapy. Medicina Oral, Patologia Oral y Cirugia Bucal. 2009; 14:e376–e383.

Martin JA, Page RC, Loeb CF, Levi PA Jr. Tooth loss in 776 treated periodontal patients. Journal of Periodontology. 2010; 81:244–250. [PubMed: 20151803]

McLellan AT, Luborsky L, Woody GE, O'Brien CP. An improved diagnostic evaluation instrument for substance abuse patients. The Addiction Severity Index. Journal of Nervous and Mental Disease. 1980; 168:26–33. [PubMed: 7351540]

Mojon P. Oral health and respiratory infection. Journal (Canadian Dental Association). 2002; 68:340–345. [PubMed: 12034069]

Molendijk B, Ter Horst G, Kasbergen M, Truin GJ, Mulder J. Dental health in Dutch drug addicts. Community Dentistry and Oral Epidemiology. 1996; 24:117–119. [PubMed: 8654031]

Moliterno LF, Monteiro B, Figueredo CM, Fischer RG. Association between periodontitis and low birth weight: A case-control study. Journal of Clinical Periodontology. 2005; 32:886–890. [PubMed: 15998273]

Morio KA, Marshall TA, Qian F, Morgan TA. Comparing diet, oral hygiene and caries status of adult methamphetamine users and nonusers: A pilot study. Journal of the American Dental Association. 2008; 139:171–176. [PubMed: 18245685]

Nathwani NS, Gallagher JE. Methadone: Dental risks and preventive action, Dent Update. 2008; 35:542–544. 547–548.

National Institute on Alcohol Abuse and Alcoholism. A pocket guide for alcohol screening and brief intervention. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism; 2005.

Pilinova A, Krutina M, Salandova M, Pilin A. Oral health status of drug addicts in the Czech Republic. Journal of Forensic Odonto-Stomatology. 2003; 21:36–39. [PubMed: 14686679]

Pitiphat W, Garcia RI, Douglass CW, Joshipura KJ. Validation of self-reported oral health measures. Journal of Public Health Dentistry. 2002; 62:122–128. [PubMed: 11989207]

Reece AS. Dentition of addiction in Queensland: Poor dental status and major contributing drugs. Australian Dental Journal. 2007; 52:144–149. [PubMed: 17687962]

Reece S. Dental health in addiction. Australian Dental Journal. 2009; 54:185–186. [PubMed: 19473171]

Robinson PG, Acquah S, Gibson B. Drug users: Oral health-related attitudes and behaviours. British Dental Journal. 2005; 198:219–224. [discussion 214]. [PubMed: 15731805]

Sheedy JJ. Methadone and caries. Case reports. Australian Dental Journal. 1996; 41:367–369. [PubMed: 9008991]

Sheridan J, Aggleton M, Carson T. Dental health and access to dental treatment: A comparison of drug users and non-drug users attending community pharmacies. British Dental Journal. 2001; 191:453–457. [PubMed: 11720019]

Shetty V, Mooney LJ, Zigler CM, et al. The relationship between methamphetamine use and increased dental disease. Journal of the American Dental Association. 2010; 141:307–318. [PubMed: 20194387]

Slots J. Update on general health risk of periodontal disease. International Dental Journal. 2003; 53(Suppl 3):200–207. [PubMed: 12875309]

Steinmiller CL, Greenwald M. Factors associated with nonmedical use of prescription opioids among heroin-abusing research volunteers. Experimental and Clinical Psychopharmacology. 2007; 15:492–500. [PubMed: 17924783]

ter Horst G, Molendijk B, Brouwer E, Verhey HG. Differences in dental treatment plan and planning for drug-addicted and non-drug-addicted patients. Community Dentistry and Oral Epidemiology. 1996; 24:120–123. [PubMed: 8654032]

Titsas A, Ferguson MM. Impact of opioid use on dentistry. Australian Dental Journal. 2002; 47:94–98. [PubMed: 12139280]

Versteeg PA, Slot DE, van der Velden U, van der Weijden GA. Effect of cannabis usage on the oral environment: A review. International Journal of Dental Hygiene. 2008; 6:315–320. [PubMed: 19138182]

Walsh T, Tickle M, Milsom K, Buchanan K, Zoitopoulos L. An investigation of the nature of research into dental health in prisons: A systematic review. British Dental Journal. 2008; 204:683–689. [discussion 667]. [PubMed: 18587364]

Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. Medical care. 1996; 34:220–233. [PubMed: 8628042]

Wu T, Trevisan M, Genco RJ, et al. Periodontal disease and risk of cerebrovascular disease: The First National Health and Nutrition Examination Survey and its follow-up study. Archives of Internal Medicine. 2000; 160:2749–2755. [PubMed: 11025784]

Table 1

Sample characteristics by self-rated oral health status

Characteristic	All subjects (*n* = 563)	Subjects with fair or poor self-rated oral health (*n* = 335)	Subjects with good, very good, or excellent self-rated oral health (*n* = 228)	*p*
Age at baseline, *n* (%)				
18–34	**212 (38)**	**111 (33)**	**101 (44)**	**.01**
35–49	**283 (50)**	**174 (52)**	**109 (48)**	
50+	**68 (12)**	**50 (15)**	**18 (8)**	
Age, *M* (*SD*)	**38 (10)**	**39 (10)**	**37 (10)**	**<.01**
Gender, *n* (%) male	409 (73)	241 (72)	168 (74)	.65
Education, *n* (%)				
<High school	133 (24)	89 (27)	44 (19)	.12
High school graduate	277 (49)	156 (47)	121 (53)	
>High school	153 (27)	90 (27)	63 (28)	
Current smoker	**493 (88)**	**302 (90)**	**191 (84)**	**.02**
Race, *n* (%)				
White	264 (47)	153 (46)	111 (49)	.57
Black	179 (32)	114 (34)	65 (29)	
Hispanic	75 (13)	43 (13)	32 (14)	
Other	45 (8)	25 (8)	20 (9)	
Any health insurance	446 (79)	269 (80)	177 (78)	.50
Income, *n* (%)				
<$20,000	236 (42)	153 (46)	83 (36)	.08
$20,000–$49,999	178 (32)	99 (30)	79 (35)	
$50,000+	147 (26)	81 (24)	66 (29)	
Overall health status, *M* (*SD*)[a]	**3.0 (1.0)**	**3.2 (1.0)**	**2.7 (1.0)**	**<.01**
Ever incarcerated, *n* (%) yes	438 (78)	254 (76)	184 (81)	.14
Homeless, *n* (%) yes	332 (59)	199 (59)	133 (58)	.80
Heavy alcohol use, *n* (%) yes	440 (78)	270 (81)	170 (75)	.09
Stimulant use, *n* (%) yes	382 (68)	230 (69)	152 (67)	.62
Opioid use, *n* (%) yes	378 (67)	223 (67)	155 (68)	.73
Marijuana use, *n* (%) yes	275 (49)	159 (48)	116 (51)	.43
Polysubstance use, *n* (%) yes	458 (81)	279 (83)	179 (79)	.15

Note. Bold indicates $p < .05$.

[a]Range = 1–5, where 1 is *excellent* and 5 is *poor*.

Table 2

Self-reported oral health outcomes (n = 563)

Item	*n* (%)
How would you describe the health of your teeth and gums?	
Fair or poor	335 (60)
Good, very good, or excellent	228 (40)
Compared with 1 year ago, how would you rate the health of your teeth and gums today?	
Somewhat or much worse	201 (36)
The same, somewhat, or much better	362 (64)
During the past 3 months, how much pain or distress have your teeth or gums caused you?	
Some, quite a bit, or a great deal	209 (37)
A little bit or none	354 (63)
About how long has it been since you last saw a dentist?	
More than 1 year ago, never, don't know	292 (52)
1 year ago or less	271 (48)
How many of your permanent teeth have been removed because of tooth decay or gum disease?	
6 or more	161 (29)
5 or fewer	387 (71)

Table 3

Adjusted models evaluating the associations between substance use types and oral health outcomes [a]

	Oral health outcomes									
	Unsatisfactory oral health status		Worse oral health compared with 1 year ago		Tooth/Gum pain		>1 year since last dentist visit		≥6 teeth removed	
Substance use types	**AOR (95% CI)**	***p***	**AOR (95% CI)**	***p***	**AOR (95% CI)**	***p***	**AOR (95% CI)**	***p***	**AOR (95% CI)**	***p***
Heavy alcohol use										
Yes vs. No	1.31 (0.79–2.15)	.29	1.13 (0.68–1.87)	.63	1.02 (0.62–1.67)	.95	1.16 (0.71–1.89)	.55	0.58 (0.32–1.05)	.07
Stimulant use										
Yes vs. No	0.85 (0.49–1.47)	.56	0.99 (0.58–1.70)	.98	1.15 (0.67–1.97)	.60	1.19 (0.71–2.01)	.51	1.21 (0.62–2.39)	.57
Opioid use										
Yes vs. No	1.09 (0.66–1.79)	.74	**1.72 (1.04–2.82)**	**.03**	1.54 (0.95–2.52)	.08	0.92 (0.58–1.48)	.74	1.26 (0.73–2.15)	.41
Marijuana use										
Yes vs. No	0.69 (0.45–1.06)	.09	0.76 (0.50–1.15)	.19	0.81 (0.54–1.22)	.32	0.77 (0.51–1.16)	.22	0.76 (0.46–1.26)	.29

Note. Bold indicates $p < .05$.

[a]Separate models were fit for each outcome, each adjusting for age, education, gender, race/ethnicity, smoking, health insurance, income, health status, lifetime incarceration, homelessness, and polysubstance use.