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The Association between the History of HIV Diagnosis and Oral Health

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Abstract

Unmet oral care needs are high among people living with human immunodeficiency virus (HIV)/AIDS (PLWH). Oral health care is of increasing importance as life expectancy is being prolonged extensively among PLWH. The benefit of oral health care in relation to time since HIV diagnosis has not previously been assessed. A retrospective multivariable analysis of the Special Project of National Significance Oral Health Initiative observational cohort study (N = 2,178) was performed to estimate the odds ratios (ORs) of oral health outcomes comparing historically diagnosed subjects (>1 y since HIV diagnosis) to newly diagnosed subjects (≤1 y since HIV diagnosis). ORs were adjusted for age, study site, language, income, last dental care visit, and dental insurance. Historically diagnosed subjects were more likely to report oral problems than newly HIV-diagnosed subjects (OR, 2.10). Historically diagnosed subjects were more likely to require oral surgery (OR, 1.52), restorative treatment (OR, 1.35), endodontic treatment (OR, 1.63), and more than 10 oral clinic visits over the 24-mo study period (OR, 2.02). The crude cumulative 2-y risk of requiring prosthetic (risk difference [RD], 0.21) and endodontic (RD, 0.11) treatment was higher among historically than newly diagnosed subjects, despite no significance postadjustment. Furthermore, poor oral health outcomes were exacerbated among non–highly active antiretroviral therapy users. Summarizing, the authors found that historically diagnosed subjects were more likely to report oral problems and require dental procedures compared with newly diagnosed subjects, suggesting that oral health among PLWH declines over time since HIV diagnosis. Hence, newly diagnosed PLWH may benefit from the implementation of early oral interventions.

Keywords: oral diagnosis, virology, health services research, dental public health, dental health survey(s), highly active antiretroviral therapy

Introduction

Oral and systemic health are intimately connected, particularly among people living with human immunodeficiency virus (HIV)/AIDS (PLWH) (Bachman, Abel, et al. 2012; Bachman, Walter, et al. 2012; Fox et al. 2012; Jeanty et al. 2012). Oral care has been cited as a primary unmet need among PLWH (Fox et al. 2012), being twice as prevalent as the unmet need for medical care among PLWH (Patton et al. 2003; Jeanty et al. 2012; Lennon et al. 2013). Oral diseases may cause pain, malnutrition, weight loss, inconsistent medication adherence, lower self-esteem, and impeded speech and can lead to social isolation and unemployment (Leao et al. 2009; Saini 2011; Bachman, Abel, et al. 2012), exacerbating the overall health and quality of life of PLWH.

The introduction of highly active antiretroviral therapy (HAART) has led to decreased incidence of oral diseases such as oral candidiasis and Kaposi sarcoma (Patton et al. 2000; Hodgson et al. 2006; Shiboski et al. 2015). However, HIV-associated salivary gland disease and human papillomavirus (HPV)–associated oral warts have increased among PLWH in the post-HAART era (Greenspan et al. 2001; Jeffers and Webster-Cyriaque 2011; Burger-Calderon et al. 2014; Burger-Calderon and Webster-Cyriaque 2015). Furthermore, conventional oral diseases of the teeth and gums remain prevalent in this population (Patton et al. 2003; Fox et al. 2012; Jeanty et al. 2012). HIV-induced chronic immune system depletion increases the chance of experiencing oral opportunistic infections and general oral health decay (Leigh et al. 2004). Finally, HAART-mediated dry mouth (xerostomia) diminishes the antimicrobial effect of saliva in the mouth, leading to subsequent increased tooth decay and potentially periodontal disease (Nittayananta et al. 2010; Fox et al. 2012).

Oral health care implementation among PLWH has been advocated (Ramos-Gomez and Folayan 2013; World Health Organization 2014), but the benefit of oral health care in

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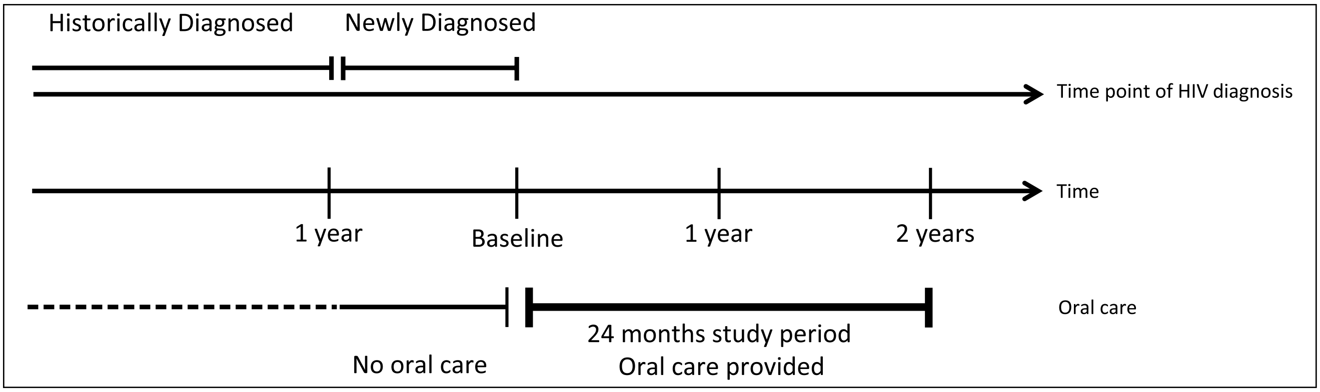

Figure. Graphic depiction of the time frame relating to oral care (prior and during the 24-mo study) to time point of human immunodeficiency virus (HIV) diagnosis. Historically diagnosed subjects were diagnosed with HIV for longer than a year prior to the baseline study collection (1980–2008), whereas newly diagnosed subjects (2007–2009) were diagnosed with HIV a year or less prior to baseline data collection.

relation to time since HIV diagnosis has not previously been assessed. Early HAART treatment among PLWH generally leads to a more effective HIV treatment course, better retention in care, more effective HIV viral load (VL) suppression, and a lower financial burden over the long term (Oxenius et al. 2000; Paredes et al. 2000; Fleishman et al. 2010; McNairy et al. 2013; Anglemyer et al. 2014; Ananworanich et al. 2015). Similarly, providing oral care soon after HIV diagnosis may be important not only for the optimal treatment of HIV-related oral lesions and disease (Coogan et al. 2005) but also for the overall health and quality of life of PLWH. The few studies focusing on the time since HIV seroconversion have focused on mucosal disease and found that 1) oral lesions may occur soon after HIV seroconversion and that 2) unmet oral care needs appear to increase over time (Lifson et al. 1994; Jeanty et al. 2012).

The Special Project of National Significance (SPNS) Oral Health Initiative Study baseline data were retrospectively examined to determine whether historically diagnosed HIV-positive individuals (>1 y since HIV diagnosis) were more likely to experience detrimental oral health outcomes than newly HIV diagnosed subjects (≤1 y since HIV diagnosis). In addition, the cumulative 2-y risk of requiring specific oral treatments was determined among historically and newly HIV-diagnosed subjects. Importantly, all of the study subjects were out of regular oral care, not having received oral care for at least 1 y prior to baseline data collection. This study expands on the literature on the timely aspect of oral health interventions among PLWH and has the potential to improve the existing public health policies guiding the oral health services provided to HIV-positive individuals.

Materials and Methods

Study Description

The SPNS Oral Health Initiative parent study, conducted by the US Health Resources and Service Administration (HRSA), intended to increase access to and promote retention in oral health for persons living with HIV (Innovations in Oral Health Care Initiative 2015). The data set (N = 2,469 HIV-positive individuals) covered 12 US states, including rural and urban districts, and 1 US territory (Fox et al. 2012). Fifteen study sites were located in New York, New York; San Francisco, California; Miami, Florida; New Orleans, Louisiana; Chapel Hill, North Carolina; Eugene, Oregon; US Virgin Islands; Lane County, Oregon; Norwalk, Connecticut; Provincetown, Massachusetts; Chester, Pennsylvania; Jefferson, South Carolina; Tyler, Texas; and Green Bay, Wisconsin. The study sites delivered various models of oral health care in university hospital dental clinics, community health centers, private dental offices, mobile dental units, and AIDS service organizations (Fox et al. 2012). This study conformed to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies.

The present secondary data analysis was based on baseline data (N = 2,178) collected prior to care (2007–2009) and the cumulative service utilization data collected throughout the 24-mo study period (Fig.). This study was missing all the data from the New Orleans, Louisiana, site and therefore covered only 14 sites. The 3 New York sites, encompassing the Bronx (n = 58), Brooklyn (n = 90), and Manhattan (n = 289), were combined into one site due to the low subject numbers at the Bronx and Brooklyn sites and due to the comparable outcome prevalences among these sites, ending in a total of 12 sites.

Recruitment, Data Collection, and Inclusion Criteria

The recruitment and data collection techniques and inclusion criteria have been previously published (ECHO 2015; Fox et al. 2012). Briefly, each study site recruited subjects through direct outreach, in collaboration with social services and HIV case managers, and through referrals from HIV clinics. Data collection tools included questionnaires provided over 5 time points (baseline, 6, 12, 18, and 24 mo) and contained information of HIV-positive individuals who were 18 y of age or older and had experienced no routine or preventive oral care within the past 12 mo, ensuring a lack of routine oral care for at least 1 y since baseline among all participants (Fig.).

Exposure

The self-reported exposure variable "time since HIV diagnosis" was based on the following questionnaire item: "When did you first test positive for HIV?" and was categorized into a binary-level covariate: newly diagnosed subjects who have been diagnosed with HIV for a year or less at baseline (≤1 y since HIV diagnosis; $n = 219$) and historically diagnosed subjects who have been diagnosed with HIV for longer than 1 y (>1 y since HIV diagnosis; $n = 1{,}959$) (Fig.). The 1-y cutoff was based on clinical recommendations indicating that oral health of newly infected individuals may decline within a year without proper oral care (UNC Dental Clinic, personal communication, 2015).

Outcomes and Other Covariates

All oral health problems were based on self-reported data, whereas oral service utilization data were based on clinical chart data (provided dental and oral services throughout the 24-mo study period). HIV VLs and CD4 counts were based on most recently recorded chart data prior to interview. Most of the recorded chart information was collected within the same year of baseline data collection. The following self-reported major independent variables, based on single-item questionnaire elements, served as proxy for the level of oral health among the HIV-positive subjects. A structured baseline interview was conducted in person, upon enrollment at each site as previously described (Fox et al. 2012). Subjects were asked to check all the items that applied based on the following questions: 1) "In the past 12 mo, have you had any of the following problems?" Possible answers included sores in mouth, growths or bumps in your mouth, bleeding gums, toothache, tooth decay/cavity, loose teeth, bad breath, sensitivity in your tooth/gums, pain in your jaw joints, or dissatisfied with the appearance of your teeth (Table 1; self-reported oral problems). 2) "How would you describe the health of your teeth and gums?" Possible answers: excellent, very good, good, fair, or poor. Self-perceived oral health (SPOH) was based on this single-item question and coded as a binary variable: poor (fair and poor) and good (excellent, very good, and good). 3) "During the past 3 mo, how often have you experienced the following difficulties because of problems with your teeth, mouth or dentures? Have you had to avoid eating food? Have you found it difficult to relax? Have you avoided going out?" Possible answers: never, hardly ever, occasionally, and fairly often. The answers were subsequently coded as a binary outcome: no (never) and yes (hardly ever, occasionally, and fairly often). The following oral treatments were provided, as well as the cumulative 24-mo procedure frequency, based on clinical records: preventive (cleaning), restorative (fillings, caries-related fixing), endodontic (root canal due to bad caries or trauma), periodontics (gum-related disease), removable prosthodontics (removable dental prosthetics), oral surgeries (any oral surgery, including extractions), and total number of oral clinic visits.

Statistical Analysis

Prevalence and odds ratios (ORs) adjusted for age and study site were calculated via a multivariable logistic regression model to identify predictors of being historically diagnosed (>1 y since HIV diagnosis) for HIV-positive adults enrolled at baseline. Respective P values (χ^2) were used to examine whether covariates differed by historical diagnosis (Table 1). ORs were adjusted for age (continuous), study site (categorical), language (categorical), income (numerical), last dental care visit (categorical), and dental insurance (categorical); stratified by HAART (binary); and estimated via a logistic regression model (Table 2). The confounders were identified based on the directed acyclic graph (DAG) (Cushing et al. 1986; Jones et al. 2001; Reznik 2005; Hodgson et al. 2006; Andrade et al. 2012; Jeanty et al. 2012).

Based on clinical records, the total number of prosthodontic, preventive, periodontic, endodontic, and restorative treatments and oral surgeries provided over the total 24-mo study period was determined. Furthermore, the crude 2-y risk along with the crude and age-adjusted risk differences (RDs) of requiring each treatment (comparing historically and newly HIV-diagnosed subjects) was assessed, while omitting individuals who missed the final 24-mo visit (Table 3). For the adjustment, the functional form of the age covariate was changed from continuous to categorical (3 categories: ≤40, 41–50, >50 y) due to insufficient observations and to converge the model. The 2-y risk calculation analysis was adjusted for age only due to lack of sufficient observations. All analyses were conducted using SAS version 9.4 (SAS Institute).

Results

Population Characteristics at Baseline

The mean age of the HIV-positive population at baseline was 44 y (range, 18–81 y). Most of the individuals self-identified as male (75%), 40% black, 33% white, and 22% Hispanic. English speakers encompassed (85%) of the study population. Most of the participants were homeowners (59%), whereas 25% rented and 16% reported temporary or no housing. Forty-one percent of the participants had an education level beyond high school, and most participants were unemployed (71%). The most commonly reported monthly household income was over $850 (44%).

The mean number of years since HIV diagnosis was 10.3 y, and 10% of the baseline population had been diagnosed with HIV within the past 12 mo (newly diagnosed; $n = 219$). Among subjects with detectable HIV VLs ($n = 1{,}106$), the mean HIV VL was 28×10^3 copies/mL (range, undetectable to 48×10^5 copies/mL). The mean CD4 count was 443 cells/mm^3 (range, 0–2,000 cells/mm^3), and 35% of the population had CD4 counts above 500 cells/mm^3. Most subjects (77%) were on HAART.

At baseline, 41% of subjects reported being in very good or excellent overall health, 33% reported being in good overall

Table 1. Characteristics and Predictors of Being Historically Diagnosed (>1 y since HIV Diagnosis) among HIV-Positive Adults Enrolled at Baseline in the Oral Health Initiative Study (2007–2009).

Characteristic	*N*	Historically HIV Diagnosed, %	Odds Ratio[a] (95% CI)
Total	2,178	90	
Age, y			
<40	651	79	1.00 (referent)[b]
40–49	908	94	3.87 (2.79, 5.36)
≥50	619	96	6.28 (4.03, 9.77)
Sex			
Male	1,626	90	1.00 (referent)
Female	529	89	0.88 (0.62, 1.25)
Transgender	23	91	0.75 (0.17, 3.39)
Race			
White	710	91	1.00 (referent)
Black	880	90	0.79 (0.52, 1.19)
Hispanic	475	88	0.66 (0.41, 1.06)
Other[c]	113	91	0.78 (0.37, 1.68)
Language			
English	1,857	91	1.00 (referent)[b]
Spanish	277	87	0.66 (0.42, 1.03)
Other[d]	42	81	0.42 (0.18, 0.98)
Missing	2		
Socioeconomic status			
Type of housing[e]			
Renting	550	87	1.00 (referent)
Homeowner	1,283	91	1.24 (0.87, 1.76)
Temporary/no housing	340	91	1.01 (0.58, 1.76)
Missing	5		
Education			
>High school	892	91	1.00 (referent)
High school	741	90	1.02 (0.71, 1.46)
<High school	509	91	0.94 (0.63, 1.41)
Missing	36		
Employed			
Yes	634	87	1.00 (referent)
No	1,536	91	1.04 (0.75, 1.44)
Missing	8		
Monthly household income			
None	362	86	1.00 (referent)[b]
≤$850	812	92	1.47 (0.97, 2.25)
>$850	964	91	1.54 (1.02, 2.32)
Missing	40		
Health-related characteristics			
Overall health category			
Fair/poor	563	91	1.00 (referent)
Good	731	89	0.80 (0.53, 1.19)
Very good/excellent	884	90	1.09 (0.73, 1.62)
Health insurance			
No	587	82	1.00 (referent)[b]
Yes	1,572	93	2.27 (1.61, 3.21)
Missing	19		
Dental insurance			
None	1,346	88	1.00 (referent)[b]
Medicaid	664	95	1.96 (1.30, 2.95)
Private	111	88	1.61 (0.81, 3.18)
Missing[f]	57		
Time since last oral treatment			
>5 y	488	87	1.00 (referent)[b]
2–5 y	627	88	1.60 (1.10, 2.33)
<2 y	1,063	93	1.26 (0.85, 1.86)

(continued)

Table 1. (continued)

Characteristic	N	Historically HIV Diagnosed, %	Odds Ratio[a] (95% CI)
Site-related characteristics			
Data collection site (state)			
New York	437	91	1.00 (referent)[b]
Pennsylvania	206	95	1.68 (0.83, 3.40)
Wisconsin	55	78	0.37 (0.17, 0.78)
Connecticut	208	95	1.54 (0.76, 3.11)
Massachusetts	74	93	1.47 (0.55, 3.94)
Oregon	205	92	1.16 (0.62, 2.15)
South Carolina	140	91	1.13 (0.56, 2.25)
Texas	187	90	1.07 (0.59, 1.94)
California (Native American, San Francisco)	99	94	1.63 (0.66, 4.03)
California (San Francisco)	173	91	1.07 (0.56, 2.02)
Florida	265	93	1.41 (0.79, 2.53)
North Carolina	129	60	0.24 (0.11, 0.31)
Urban versus rural collection site			
Rural	1,165	92	1.00 (referent)
Urban	1,013	89	1.43 (0.65, 3.14)

CI, confidence interval; HIV, human immunodeficiency virus.
[a]Adjusted for age and site.
[b]χ^2, $P < 0.05$.
[c]Multiracial (n = 64), Asian (n = 14), Native American (n = 11), Pacific Islander (n = 3), other (n = 15), and unknown (n = 6).
[d]French (n = 13), Creole/French Creole (n = 10), and other (n = 19) as one of the answer options from the original questionnaire.
[e]Homeowner, lives in own home or apartment; renting, lives in someone else's home or apartment; temporary/no housing, lives in temporary or no housing.
[f]Included missing answers, "don't know," "other," and "Medicare."

health, and 26% reported being in fair or poor overall health. Most of the subjects benefited from health insurance (72%), but only 36% of the subjects had dental insurance coverage. Notably, 22% of baseline participants had not received oral care in more than 5 y.

Characteristics of Historically Diagnosed (>1 y since HIV Diagnosis) at Baseline

The prevalence of historically diagnosed individuals increased significantly with age (Table 1). Similarly, individuals living in a household that earned more than $850 a month were more likely to be historically diagnosed (91% prevalence) than individuals who did not have a steady monthly household income (86% prevalence; OR, 1.54; 95% CI, 1.02 to 2.32). The prevalence of historically diagnosed subjects was significantly higher among those having health insurance (93%) compared with those without health insurance (82%). As for dental insurance, the prevalence of historically diagnosed subjects was significantly higher among those having Medicaid (95%) compared with those who had no dental insurance (88%; OR, 1.96; 95% CI, 1.30 to 2.95). Furthermore, the number of recruited historically diagnosed individuals varied significantly by geographical collection study site (χ^2, $P < 0.05$).

There was no significant difference in prevalence of historically diagnosed individuals among categories of sex; race; socioeconomic status (SES)-related covariates such as housing, education, and employment; and rural (92%) versus urban (89%) residents. As for the language categories, English speakers had the highest prevalence of historically diagnosed subjects (91%) compared with Spanish, French, and Creole.

Effect Estimates of Oral Health Outcomes

Compared with newly diagnosed subjects, historically diagnosed subjects were more likely to self-report any oral problems in the 12 mo prior to baseline data collection (OR, 2.10; 95% CI, 1.30 to 3.41; Table 2). Similarly, the odds of reporting toothaches (OR, 1.44; 95% CI, 1.04 to 1.98), tooth decay or cavities (OR, 1.60; 95% CI, 1.16 to 2.19), and dental sensitivity (OR, 1.36; 95% CI, 1.00 to 1.87) in the 12 mo prior to baseline data collection were significantly higher among historically diagnosed. Effect of time since HIV diagnosis on oral health outcomes differed across HAART (based on self-reported HAART use at baseline); only historically diagnosed subjects who were not on HAART maintained the significant increase in likelihood of self-reporting poor oral health outcomes compared with newly diagnosed individuals. These outcomes included any oral problems (OR, 2.72; 95% CI, 1.17 to 6.34), toothaches (OR, 2.70; 95% CI, 1.57 to 4.64), tooth decay or cavities (OR, 2.28; 95% CI, 1.35 to 3.87), and dental sensitivity (OR, 1.74; 95% CI, 1.02 to 2.95). Difficulty eating food (OR, 1.05; 95% CI, 0.76 to 1.46), difficulty relaxing (OR, 1.31; 95% CI, 0.94 to 1.83), and avoiding going out (OR, 1.28; 95% CI, 0.87 to 1.87) due to oral problems were equally likely to be reported by historically and newly diagnosed individuals. Similarly, the odds of reporting poor SPOH did not differ significantly comparing historically and newly diagnosed individuals at baseline (OR, 1.10; 95% CI, 0.79 to 1.52).

Table 2. Baseline ORs of Having Outcome Characteristic and Corresponding 95% CIs among Those Who Were Historically Diagnosed (>1 y since HIV Diagnosis at Baseline) Compared with Those Who Were Newly Diagnosed (≤1 y since HIV Diagnosis at Baseline, Referent), Stratified by Current HAART Status.[a]

				No HAART			HAART		
Outcome Characteristic	Total	Historically Diagnosed,[b] %	OR[c] (95% CI)	*N*	Historically Diagnosed,[b] %	OR[c] (95% CI)	*N*	Historically Diagnosed,[b] %	OR[c] (95% CI)
	2,178	90		490	80		1,679	93	
Self-reported oral problems in the 12 mo prior to baseline									
Experienced any oral problems									
No	210	86		39	67		169	91	
Yes	1,968	90	**2.10**[d] (1.30 to 3.41)	451	81	**2.72**[d] (1.17 to 6.34)	1,510	93	1.88 (0.97 to 3.62)
Specific oral problems experienced[e]									
Toothache									
No	1,244	90		242	75		997	94	
Yes	934	90	**1.44**[d] (1.04 to 1.98)	248	86	**2.70**[d] (1.57 to 4.64)	682	92	0.99 (0.66 to 1.51)
Tooth decay/cavity									
No	1,046	89		213	74		828	93	
Yes	1,132	91	**1.60**[d] (1.16 to 2.19)	277	85	**2.28**[d] (1.35 to 3.87)	851	93	1.32 (0.87 to 1.99)
Dental sensitivity									
No	1,070	89		198	76		866	92	
Yes	1,108	91	**1.36**[d] (1.00 to 1.87)	292	83	**1.74**[d] (1.02 to 2.95)	813	93	1.30 (0.85 to 1.97)
Service utilization over 24-mo study period									
Oral surgery[f]									
No	1,380	91		300	81		1,073	94	
Yes	798	88	**1.52**[d] (1.02 to 2.27)	190	80	1.43 (0.77 to 2.68)	606	90	1.58 (0.91 to 2.74)
Restorative treatment									
No	973	89		252	80		717	93	
Yes	1,205	91	**1.35**[d] (1.00 to 1.85)	238	80	1.26 (0.75 to 2.11)	962	93	1.21 (0.79 to 1.86)
Endodontic treatment									
No	1,879	90		441	80		1,433	93	
Yes	299	93	**1.63**[d] (1.00 to 2.77)	49	84	1.14 (0.45 to 2.88)	246	95	1.77 (0.89 to 3.50)
More than 10 clinic visits over 24-mo study									
No	1,712	89		418	80		1,286	92	
Yes	466	94	**2.02**[d] (1.30 to 3.21)	72	88	1.49 (0.64 to 3.46)	393	95	**1.97**[d] (1.10 to 3.51)

CI, confidence interval; HAART, highly active antiretroviral therapy; HIV, human immunodeficiency virus; OR, odds ratio.
[a]*n* = 9 missing.
[b]Historically diagnosed (>1 y since HIV diagnosis).
[c]Odds ratio adjusted for age, site, language, income, last dental care visit, and dental insurance.
[d]Bold values are statistically significant.
[e]Based on the question, "In the past 12 mo, have you had any of the following problems?"
[f]Including tooth extractions.

Based on the cumulative 24-mo service utilization data, historically diagnosed subjects had a significantly higher likelihood of requiring oral surgeries (OR, 1.52; 95% CI, 1.02 to 2.27), restorative treatments (OR, 1.35; 95% CI, 1.00 to 1.85), endodontic treatments (OR, 1.63; 95% CI, 1.00 to 2.77), and more than 10 oral clinic visits (OR, 2.02; 95% CI, 1.30 to 3.21) compared with newly diagnosed subjects at baseline (Table 2). Once stratifying the effect estimates of the exposure-service utilization relationship by HAART (self-reported at baseline), only a significant increase in more than 10 oral clinic visits over the full 24-mo study period remained, compared with their newly diagnosed counterparts (OR, 1.97; 95% CI, 1.10 to 3.51).

The crude cumulative 2-y risk of requiring prosthetic procedures was significantly higher among historically diagnosed (RD, 0.21; 95% CI, 0.04 to 0.37, compared with newly diagnosed subjects; Table 3), while the significance was lost after the age adjustment. Similarly, the crude 2-y risk of requiring endodontic treatment was significantly higher among historically diagnosed (RD, 0.11; 95% CI, 0.00 to 0.22, compared with newly diagnosed subjects), while the significance was lost after the age adjustment. The crude risk of requiring restorative treatment was higher among historically diagnosed (RD, 0.18; 95% CI, −0.02 to 0.38, compared with newly diagnosed subjects), despite the difference not being statistically significant. The crude risk of requiring oral surgeries (RD, −0.06; 95% CI, −0.26 to 0.14) or preventive treatments (RD, −0.04; 95% CI, −0.19 to 0.11, compared with newly diagnosed subjects) was slightly lower among historically diagnosed, while again not being statistically significant.

Discussion

To our knowledge, this study is the first to analyze conventional oral health outcomes in relation to time since HIV

Table 3. Cumulative 2-y Risk Difference of Requiring Specific Oral Treatments Comparing Historically Diagnosed (*n* = 400) to Newly Diagnosed (*n* = 25, Referent) Subjects over the 24-mo Study Period.[a]

Treatment Type	*N*[b]	Historically Diagnosed[c]	*N*[b]	Newly Diagnosed[d]	Crude Risk Difference[e] (Historically–Newly Diagnosed) (95% CI)	Adjusted Risk Difference[f] (Historically–Newly Diagnosed) (95% CI)
Total	400		25			
Oral surgeries[g]	200	0.50	14	0.56	−0.06 (−0.26 to 0.14)	−0.05 (−0.25 to 0.15)
Prosthodontics[h]	162	0.41	5	0.20	**0.21** (0.04 to 0.37)[i]	0.13 (−0.02 to 0.29)
Preventive treatments[h]	319	0.80	21	0.84	−0.04 (−0.19 to 0.11)	−0.03 (−0.18 to 0.12)
Periodontics[h]	207	0.52	13	0.52	0.00 (−0.20 to 0.20)	−0.002 (−0.20 to 0.21)
Endodontics[h]	76	0.19	2	0.08	**0.11** (0.00 to 0.22)[i]	0.12 (−0.01 to 0.24)
Restorative[h]	281	0.70	13	0.52	0.18 (−0.02 to 0.38)	0.16 (−0.04 to 0.36)

CI, confidence interval.
[a]Based on clinical records, omitting subjects who missed the final 24-mo visit.
[b]Number of oral treatment events.
[c]The 2-y crude risk of requiring specific oral treatments for historically diagnosed subjects (>1 y since HIV diagnosis).
[d]The 2-y crude risk of requiring specific oral treatments for newly diagnosed subjects (≤1 y since HIV diagnosis).
[e]Crude risk difference.
[f]Risk difference adjusted for age (3 categories: ≤40, 41–50, >50 y).
[g]Including tooth extractions.
[h]Prosthodontics: removable dental prosthetics; preventive treatments: cleaning; periodontics: gum-related disease treatments; endodontics: root-canal therapy.
[i]Bold values are statistically significant.

diagnosis in a large HIV positive cohort. Among the 2,178 HIV-seropositive individuals from the US-based SPNS study, historically diagnosed subjects were more likely to report oral problems, toothaches, tooth decay or cavities, and/or dental sensitivity in the 12 mo prior to baseline data collection compared with newly diagnosed individuals. Historically diagnosed subjects were also more likely to require oral surgeries, restorative treatments, endodontic treatments, and more than 10 clinic visits over the 24-mo study period compared with newly diagnosed subjects. Hence, at baseline, historically HIV-diagnosed subjects had worse oral health compared with newly HIV-diagnosed subjects, and these effects were exacerbated among non-HAART users. The crude 2-y cumulative risk of requiring prosthetic and endodontic treatment was significantly higher among historically diagnosed compared with newly diagnosed subjects. Our results suggest that oral health care declined within the first year of HIV diagnosis, emphasizing a potential benefit of introducing oral health care soon after HIV diagnosis.

Few studies have focused on conventional oral health needs instead of oral mucosal manifestations related to HIV infection (Greenspan 1997; Margiotta et al. 1999; Patton et al. 2002). Historically diagnosed subjects in our study were more likely to report oral problems such as toothache, cavity, and dental sensitivity at baseline. These results are consistent with a recently published study, also based on the SPNS Oral Health Initiative, which found that "each additional year of having been diagnosed with HIV was positively associated with a 1.5% increase in unmet dental care needs (OR: 1.015; 95% CI 1.004, 1.027)," despite the study focusing on oral care barriers among PLWH (Jeanty et al. 2012). A US study (1994) found that among homosexual HIV-positive men, oral candidiasis or hairy leukoplakia appeared in 30% of the subjects within 3 y after HIV seroconversion, in 50% of the subjects within 5 y after HIV seroconversion, and before progression to AIDS (Lifson et al. 1994). While the study does not directly relate to the oral health outcomes measured in this study, it confirms the findings that historically diagnosed subjects were more prone to require oral procedures such as oral surgeries, restorative treatments, endodontic treatments, and more than 10 clinic visits over the full 24-mo study period compared with newly diagnosed patients. The probability of requiring prosthodontic, periodontic, or preventive treatments, on the other hand, did not differ significantly comparing historically to newly diagnosed subjects in our study.

Interestingly, the likelihood of reporting oral problems and requiring oral treatments varied significantly across HAART and non-HAART users. Long-term HIV survivorship and consistent HAART adherence, consequently undetectable viremia, and elevated CD4 counts are strongly associated (Jevtovic et al. 2007; Machado 2012). Similarly, 72% of historically diagnosed subjects were on HAART at baseline in our study. Historically diagnosed subjects who were not on HAART demonstrated a significant increase in the likelihood of self-reporting poor oral health outcomes compared with newly diagnosed individuals, especially for toothache. However, the differences in point estimates were slight, and the 95% CI overlapped. Still, these findings may merit further examination of oral health outcomes among PLWH and their modification by HAART since the lack of HAART may drive poor oral health outcomes among the historically diagnosed subjects.

Using prevalence ORs in the context of time since HIV diagnosis allowed the identification of potential associations and risk factors for oral health in this vulnerable population, while acknowledging that inferring causality based on an observational study design is limited. The large sample size and the comprehensive geographical spread of the multisite study strengthened the findings. To our knowledge, no other published study has methodically searched for a potential association between oral health outcomes, oral service utilization, and time since HIV diagnosis.

Some limitations merit consideration. First, this cohort represented a convenience sample selected through multiple outreach methods in both urban and nonurban settings and geographic locations, thereby limiting generalizability. Second, the main exposure "time since HIV diagnosis" and time since actual HIV infection may have differed since the exposure was self-reported. Hence, recall bias may have been an error source. The analysis attempted to account for the potential misclassification bias by taking factors into consideration that may have affected the discrepancy between HIV diagnosis and time point of infection, such as SES and insurance status. The self-reported nature of the oral health outcomes may be perceived as limitation. However, self-reported health and oral health outcomes in general have been endorsed widely (Benyamini et al. 2004; Ohara et al. 2015). Single-item questions similar to the ones used for the evaluation of oral health outcomes in this study have been successfully validated in several studies (Benyamini et al. 2004; Ohara et al. 2015) and are powerful predictors of both functional decline and survival and successfully predict use of health care services (Locker et al. 2005).

In conclusion, our data support considering policy implementations that would provide oral health care to newly HIV-diagnosed individuals to effectively reduce oral morbidity and alleviate the substantial oral health care need among HIV-positive individuals.

Author Contributions

R. Burger-Calderon contributed to conception and design, analysis, interpretation, and drafted and critically revised the manuscript. J. S. Smith, K. J. Ramsey, and J. Webster-Cyriaque contributed to conception and design, data analysis, and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of the work.

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