Oral health and health-related quality of life in HIV patients

Vinicius da Costa Vieira, Liliane Lins, Viviane Almeida Sarmento, Eduardo Martins Netto and Carlos Brites

Abstract

Background: Oral health care may improve the health-related quality of life (HRQoL) of HIV/AIDS patients. We aimed to evaluate oral health and HRQoL of HIV/AIDS patients using antiretroviral therapy.

Methods: A cross-sectional study included 120 HIV-infected patients, aged ≥18 years, from February, 2016 to September, 2017. The 36-Item Short Form Health Survey (SF-36) was used to evaluate the HRQoL. We assessed dental caries status using the Decayed, Missing and Filled Teeth (DMFT) index. Information about demographic, socioeconomic status, depression, and other comorbidities were collected. All patients with depression had a medical diagnosis. Comorbidities were defined as medical diagnoses of arterial hypertension, type-2 diabetes, tuberculosis, syphilis, cardiopathy, chronic renal failure, lymphoma, HCV infection, HBV infection and fatty liver disease. Independent t-tests were used to compare differences between mean levels of HRQoL, age, and DMFT and its components according to groups of sex, comorbidities and depression. Simple linear regression was used to analyze the relationship between the Mental Component Summary (MCS) and DMFT, and a multiple regression equation investigated depression, age, MCS, and comorbidities as predictors of DMFT.

Results: The mean DMFT index was 12.4 ± 8.2. A linear regression equation estimated a significant (p = 0.022) decrease of 0.25 unit (%) in MCS for each unit increase in DMFT. Among depressed patients, a significant (p = 0.008) decrease of 0.67% in MCS for each unity increase in DMFT was estimated. Depressed patients showed worse oral health indicators (DMFT index; p ≤ 0.001; and mean Missing Teeth; p ≤ 0.052) and lower HRQoL domains than non-depressed patients. DMFT remained associated with depression (P < 0.005) after controlling for age, MCS, and comorbidities.

Conclusions: We found association between poorer oral health (higher DMFT index) and lower Mental Health Component Summary in HIV-infected patients with depression. Patients with depression deserve especial attention to their HRQoL and oral care.

Keywords: Health-related quality of life, Oral health, Depression, HIV

Background

The proper use of antiretroviral therapy (ART) has extended the life expectancy of people living with HIV/AIDS [1]. In consequence, several health-related outcomes have been observed, that contributed to a higher frequency of chronic comorbidities [2–4], depression and depressive symptoms [5, 6] that lead to a poorer health-related quality of life (HRQoL) [3, 6–8] and increases the risk of low adherence to ART [9]. Assessing depression symptoms before initiating ART may be effective to improve adherence and characterize the health-related quality of life of these patients [10]. The assessment of the health-related quality of life became an integral part of HIV/AIDS patients' follow-up [4].

In the past, detection of oral health lesions were often useful in the clinical diagnosis of HIV/AIDS infection, particularly among immunosuppressed patients [11]. There is no consensus about the association of poor oral health, particularly measured by DMFT index, with HIV infection. Some reports have shown greater risk for development of dental caries in HIV patients during antiretroviral drugs treatment [12, 13]. Another study reported a decrease in the incidence of dental caries following
antiretroviral therapy [14]. A study among HIV-positive patients reported higher levels of immune activation markers HLA-DR and CD38 expressions in the peripheral blood when oral lesions were present [15], suggesting that oral health may significantly impact the immune response of HIV patients, including those under suppressive ART. However, HLA-DR and CD38 levels did not vary substantially according to the DMFT index.

Oral health care may improve the HRQoL of HIV/AIDS patients. A study in HIV patients has reported higher DMFT index associated with poorer Oral Health–Related Quality of Life [16]. However, this study did not investigate the association between DMFT index and the SF-36 domain scores. The SF-36 questionnaire is a widely used instrument to evaluate HRQoL, based on two different constructs, the Physical Component and the Mental Component [17]. This study aimed to evaluate the oral health and HRQoL of HIV/AIDS patients in use of ART.

**Methods**

**Study design and participants**

This is a cross-sectional study of HIV-infected patients, aged 18 years or more, consecutively recruited at the HIV Clinic of the University Hospital Professor Edgard Santos, Federal University of Bahia, Salvador, Bahia, Brazil, between February 2016 and September 2017. We excluded from the study patients unable to communicate or who had difficulty to understand SF-36 questionnaire.

**Assessment**

Information about demographic, socioeconomic status, clinical history, HIV-1 RNA plasma viral load and CD4/CD8 cells count were collected from each patient during medical examination, using a structured questionnaire. The 36-Item Short Form Health Survey (SF-36) was used to evaluate the HRQoL. We used the SF-36 as recommended by QualityMetric Incorporated [17] to generate eight domains - physical functioning (PF), role limitations due to physical problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE) and mental health (MH). The raw score of these domains varies from 0 to 100, where 100 represents the best HRQoL. SF-36 scores were normalized, assuming a mean of 50 and a standard deviation of 10, taking the general population of the USA as standard. The normalized domains were aggregated into either Physical Component Summary (PCS) or Mental Component Summary (MCS) [17]. Our study was licensed by Quality-Metric Health Outcomes™ under number QM025905.

We used the World Health Organization and the European Association of Dental Public Health criteria for oral health status evaluation [18, 19]. We measured clinical attachment loss, probing pocket depth and tooth mobility to evaluate periodontal disease. The number of Decayed, Missing and Filled Teeth were determined. Cariogenic diet was accessed using open questions in the structured questionnaire. The same researcher has evaluated all patients. The intrarater reliability (k = 0.67) was substantially satisfactory, as measured by the Kappa statistics [20]. Stimulated salivary flow measured less than 1 mL/min was considered as reduced [21].

**Statistical analysis**

Health-related quality of life (HRQoL) [17] and the number of Decayed, Missing and Filled Teeth (DMFT index) [18] were considered as dependent variables. Independent t-tests were used to compare differences between mean levels of HRQoL, age, and DMFT and its components according to groups of sex, comorbidities and depression. Simple linear regression technique was used to analyze the relationship between MCS and DMFT, and a multiple regression equation investigated age, depression, MCS, and comorbidities as predictors of DMFT. All patients with depression had a medical diagnosis. Comorbidities were defined as medical diagnoses of arterial hypertension, type-2 diabetes, tuberculosis, syphilis, cardiopathy, chronic renal failure, lymphoma, HCV infection, HBV infection and fatty liver disease. Data were analyzed by using the Statistical Package for the Social Sciences 18 (SPSS).

**Ethical procedures**

The study was approved by the Ethics Review Board of University Hospital Professor Edgard Santos, Federal University of Bahia under the Certificate of Presentation of Ethical Appreciation (CPEA 57172216.2.0000.0049) in accordance with the Declaration of Helsinki 2013 and the National Council Resolution 466/12 and. All participants were informed and signed a consent form approved by the Ethics Board.

**Results**

The study enrolled 120 patients (64 males; 56 females). Age ranged from 20 to 72 years, and the mean (±SD) was 44.9 ± 11.7 years. Most were Mulatto (57.5%) or Black (24.2%) and were not in a stable relationship (73.3%). Thirty-six (30.0%) of the patients had elementary schooling level (four or less years); 70.8% were non-smokers; 65.0% consumed alcohol, and 28 (23.3%) had diagnosis of depression.

Arterial hypertension was present in 22 (18.3%) patients, type-2 diabetes in seven (5.8%), tuberculosis in eight (6.7%), syphilis in six (5.0%), cardiopathy in four (3.3%), chronic renal failure in two (3.5%) and lymphoma in one (0.8%). Of the patients with hepatic comorbidities, five (4.2%) had HCV, three (2.5%) HBV and three (2.5%) had fatty liver disease. Periodontitis and gingivitis
were found in 52 (46.4%) and 47 (42.0%) of dentate patients, respectively. Twenty-four patients (20.0%) had reduced salivary flow; and the mean DMFT index was 12.4 ± 8.2 (1.1 ± 1.9 decayed teeth; 7.9 ± 8.7 missing teeth and 3.4 ± 4.0 filled teeth). Eighty patients (66.7%) had CD4 counts equal or greater than 500 cells/mm³ and 75 (62.5%) had undetectable viral load (Table 1).

Patients with comorbidities were older (47.2 ± 11.0 vs. 42.4 ± 11.9; \( P = 0.026 \)), and presented higher mean DMFT (14.0 ± 7.9 vs. 10.7 ± 8.2; \( P = 0.026 \)). All SF-36 normalized mean scores were systematically lower in patients with comorbidities. Among patients with comorbidities, means of all SF-36 domains were significantly lower (\( P < 0.05 \)), except for MH (Table 2). Women showed SF-36 scores systematically lower than men in all domains, and means of RP (0.006), BP (0.016), VT (0.044), MH (0.001) and MCS (0.013) were significantly lower. Compared to males, females presented higher mean DMFT (\( P < 0.001 \)) and mean Missing Teeth indexes (\( P < 0.033 \)) (Table 3).

A linear regression equation estimated a significant (\( p = 0.022 \)) decrease of 0.25 unit (%) in MCS for each unit increase in DMFT. Among depressed patients, a significant (\( p = 0.008 \)) decrease of 0.67% in MCS for each unity increase in DMFT was estimated. (Fig. 1 and Table 4). Depressed patients showed worse oral health indicators (DFMT index; \( p \leq 0.001 \) and mean Missing Teeth; \( p \leq 0.052 \)) and lower HRQoL domains than those without depressive symptoms. DMFT remained associated with depression (\( P < 0.005 \)) after controlling for age, MCS, and comorbidities.

**Discussion**

Depression is the most common prevalent neuropsychiatric symptom in HIV-1 patients [5]. According to our results, patients with depression had higher mean of missing teeth than patients without depression (\( P \leq 0.052 \)). A linear regression equation predicted a significant (\( P < 0.008 \)) decrease of 0.67 unit (%) in MCS for each unit of DMFT.

| Table 1 Demographic and clinical characteristics of 120 HIV-infected patients, Salvador, Bahia, 2017 |
| Demographic and clinical characteristic |
| Age, mean SD |
| 44.9 ± 11.7 |
| Sex N (%) |
| Male |
| 64 (53.3) |
| Female |
| 56 (46.7) |
| Marital status N (%) |
| Single |
| 88 (73.3) |
| Married/stable relationship |
| 32 (26.7) |
| Ethnicity N (%) |
| Caucasian |
| 22 (18.3) |
| Mulatto |
| 69 (57.5) |
| Black |
| 29 (24.2) |
| Educational status N (%) |
| Elementary |
| 36 (30.0) |
| High School |
| 66 (55.0) |
| College |
| 18 (15.0) |
| Alcohol consumption N (%) |
| Yes |
| 78 (65.0) |
| No |
| 42 (35.0) |
| Smoking status N (%) |
| Non Smoker |
| 85 (70.8) |
| Smoker |
| 35 (29.2) |
| Comorbidities N (%) |
| Yes |
| 62 (51.7) |
| No |
| 58 (48.3) |
| Depression N (%) |
| Yes |
| 28 (23.3) |
| No |
| 92 (76.7) |
| Daily dental brushing N (%) |
| \( \geq 3 \) times |
| 58 (48.3) |
| < 3 times |
| 62 (51.7) |
| Dental floss use N (%) |
| Yes |
| 51 (42.5) |
| No |
| 69 (57.5) |
| Cariogenic diet N (%) |
| Yes |
| 65 (54.2) |
| No |
| 55 (45.8) |
| Edentulism N (%) |
| Dentate |
| 112 (93.3) |
| Edentulous |
| 8 (6.7) |
| Periodontal disease |
| Periodontitis |
| 52 (46.4) |
| Gingivitis |
| 47 (42.0) |
| No periodontal disease |
| 13 (11.6) |

\( \text{Only patients with viral loads} > \text{zero} \)
among patients with depression. Depression can decrease the likelihood of using oral health services, and is associated with teeth loss [22].

In this study, patients with HIV had a mean DMFT of 12.4. DMFT mean in patients with HIV varies around the world, ranging from 8.7 in Australia [23], to 16.9 in Portugal [24]. In Brazil, DMFT means of 16.9, 17.64 and 18.8 have been reported [25–27]. These differences in DMFT means can be attributed to hygienic behavioral, access to dental services and socioeconomic status [28, 29].

A multivariate linear regression identified age (P < 0.001) and depression (P < 0.004) as good and independent predictors of DMFT, even after adjusting for mental health and comorbidities. Correlation between age and the mean DMFT index have also been reported not only in HIV/AIDS patients [28], but also in non-HIV/AIDS patients [30]. Older age is associated with greater frequency of dental extraction due to caries, periodontal disease, and presence of comorbidities such as diabetes, hypertension or hyperlipidemia [30].

### Table 2
Mean and Standard Deviations of characteristics (Age, Oral Health Profile, and Health-related Quality of Life) of 120 patients according to comorbidities, Salvador, Bahia, Brazil, 2017

| Characteristics     | With Comorbidity (N = 62) | Without Comorbidity (N = 58) | Mean Difference | P ≤* |
|---------------------|---------------------------|-----------------------------|-----------------|------|
| Age                 | 47.2 ± 11.0               | 42.4 ± 11.9                 | 4.8             | 0.026|
| DMFT Index          | 14.0 ± 7.9                | 10.7 ± 8.2                  | 3.3             | 0.026|
| Decayed             | 1.2 ± 1.6                 | 1.2 ± 2.2                   | 0.0             | 0.652|
| Missing             | 9.2 ± 8.5                 | 6.4 ± 8.7                   | 2.8             | 0.072|
| Filled              | 3.7 ± 4.4                 | 3.1 ± 3.4                   | 0.6             | 0.377|
| Physical Functioning (PF) | 48.9 ± 9.8           | 54.8 ± 4.9                   | −5.9            | 0.001|
| Role Physical (RP)  | 40.6 ± 9.6                | 45.3 ± 8.7                   | −4.7            | 0.006|
| Bodily Pain (BP)    | 46.4 ± 11.8               | 52.5 ± 9.3                   | −6.1            | 0.002|
| General Health (GH) | 48.5 ± 10.9               | 54.1 ± 9.9                   | −5.6            | 0.004|
| Vitality (VT)       | 52.1 ± 10.8               | 56.1 ± 8.9                   | −4.0            | 0.030|
| Social Functioning (SF) | 47.5 ± 12.1             | 52.2 ± 8.1                   | −4.7            | 0.014|
| Role Emotional (RE) | 35.4 ± 11.2               | 42.2 ± 9.0                   | −6.8            | 0.001|
| Mental Health (MH)  | 46.9 ± 12.8               | 50.3 ± 9.2                   | −3.4            | 0.099|
| Physical Component Summary (PCS) | 48.3 ± 8.6           | 53.8 ± 6.9                   | −5.5            | 0.001|
| Mental Component Summary (MCS) | 43.8 ± 10.8          | 48.0 ± 8.2                   | −5.2            | 0.019|

*Independent Sample Student-t Test

### Table 3
Mean and Standard Deviations of Oral Health Profile and Health-related Quality of Life indicators of 120 patients according to sex, Salvador, Bahia, Brazil, 2017

| Indicator                  | Male (N = 64) | Female (N = 56) | Mean Difference | P ≤* |
|----------------------------|---------------|-----------------|-----------------|------|
| DMFT Index- mean (SD)      | 10.1 ± 8.0    | 15.1 ± 7.8      | −5.0            | 0.001|
| Decayed- mean (SD)         | 0.8 ± 1.4     | 1.5 ± 2.4       | −0.7            | 0.065|
| Missing- mean (SD)         | 6.3 ± 7.8     | 9.7 ± 9.3       | −3.4            | 0.033|
| Filled- mean (SD)          | 3.0 ± 3.5     | 3.9 ± 4.4       | −0.9            | 0.229|
| Physical Functioning (PF)  | 53.0 ± 7.6    | 50.4 ± 9.0      | 2.6             | 0.089|
| Role Physical (RP)         | 45.1 ± 8.2    | 40.3 ± 10.2     | 4.8             | 0.006|
| Bodily Pain (BP)           | 51.6 ± 10.0   | 46.8 ± 11.7     | 4.8             | 0.016|
| General Health (GH)        | 52.3 ± 10.3   | 50.0 ± 11.3     | 2.3             | 0.236|
| Vitality (VT)              | 55.8 ± 10.2   | 52.1 ± 9.7      | 3.7             | 0.044|
| Social Functioning (SF)    | 50.9 ± 9.3    | 48.6 ± 11.9     | 2.3             | 0.236|
| Role Emotional (RE)        | 39.7 ± 10.7   | 37.5 ± 10.8     | 2.2             | 0.247|
| Mental Health (MH)         | 52.1 ± 8.6    | 44.6 ± 12.7     | 7.5             | 0.001|
| Physical Component Summary (PCS) | 52.3 ± 7.2    | 49.4 ± 9.2      | 2.9             | 0.057|
| Mental Component Summary (MCS) | 47.9 ± 8.6    | 43.4 ± 10.6     | 4.5             | 0.013|

*Independent Sample Student-t Test
In our study, women had systematically lower mean scores of SF-36 domains, lower MCS \((P < 0.013)\) and PCS \((P < 0.057)\). Our data are according to a previous study that reported females have significant lower MCS score, but not PCS \([31]\). Our male patients presented significantly lower mean of missing teeth than the females, differing of the results reported by in an Iranian study \([28]\).

In a meta-analysis with 42,366 patients, from 111 studies, the prevalence of depressive symptoms ranged from 12.8 to 78.0% in HIV/AIDS patients using ART \([9]\). In our patients, the prevalence of depression was 23.3%, which is in accordance with the mentioned meta-analysis. The actual diagnosis of depression, as well as its previous history, have been associated with poorer HRQoL in HIV-infected patients \([32]\). The group with confirmed diagnosis of depression exhibited significantly lower means in all SF-36 domains and in physical and mental summary components. As expected, depression was more associated with mental health domains. The presence of major depressive disorders along patient’s life is correlated with both Physical and Mental summary scores of HRQoL \([2]\). Depression may also be associated with sleep disorders and appetite decrease \([8]\).

HIV-infected patients aged 50 years or older may have multiple comorbidities and risk for cardiovascular and renal diseases \([4]\). In our study, at least one comorbidity was present in 51.7% of the IHV-patients. Patients without comorbidity were 4.8 years older than those without

### Table 4

| Characteristics          | Depressed \((N = 28)\) | Nondepressed \((N = 92)\) | Mean Difference | \(P <\) |
|--------------------------|------------------------|---------------------------|-----------------|---------|
| DMFT Index- mean (SD)    | 16.9 ± 6.5             | 11.1 ± 8.2                | 5.8             | 0.001   |
| Decayed- mean (SD)       | 1.5 ± 2.0              | 1.0 ± 1.9                 | 0.5             | 0.217   |
| Missing- mean (SD)       | 10.6 ± 8.4             | 7.0 ± 8.6                 | 3.6             | 0.052   |
| Filled- mean (SD)        | 4.8 ± 4.8              | 3.0 ± 3.6                 | 1.8             | 0.083   |
| Physical Functioning (PF)| 480 ± 9.3              | 529 ± 7.7                 | −4.9            | 0.006   |
| Role Physical (RP)       | 366 ± 10.9             | 448 ± 8.1                 | −82             | 0.001   |
| Bodily Pain (BP)         | 433 ± 11.4             | 512 ± 10.4                | −79             | 0.001   |
| General Health (GH)      | 470 ± 13.2             | 525 ± 9.7                 | −55             | 0.050   |
| Vitality (VT)            | 492 ± 9.1              | 555 ± 10.0                | −63             | 0.003   |
| Social Functioning (SF)  | 441 ± 13.0             | 516 ± 9.2                 | −75             | 0.008   |
| Role Emotional (RE)      | 292 ± 10.8             | 416 ± 9.0                 | −124            | 0.001   |
| Mental Health (MH)       | 399 ± 13.6             | 512 ± 9.1                 | −11.3           | 0.001   |
| Physical Component Summary (PCS) | 478 ± 9.1 | 519 ± 7.8                | −41             | 0.021   |
| Mental Component Summary (MCS) | 37.1 ± 8.8 | 48.5 ± 8.5               | −11.4           | 0.001   |

\*Independent Sample Student-t Test
comorbidities, what may partially explain the worse mean DMFT. The group with comorbidities also presented lower means of PCS and MCS scores. The negative effect of comorbidities, specifically on the physical domains of HRQoL, has been also reported [2]. On the other hand, our patients were in use of ART for at least one year, so we can assume that they had enough time to get benefits from this medical treatment, including in their HRQoL. Improvements in physical and mental aspects of HRQoL were reported in patients using ART for one year [31].

Our study has some limitations. First, we used a cross-sectional design that have inherent methodological limitations, like the difficulty to establish the correct temporal sequence of exposure and effect. Our patients were recruited from a single reference center for HIV-infected patients. We did not take the exposure duration to ART into consideration in our analysis. The results of some clinical data were obtained from medical records. We did not have an HIV-uninfected population to compare the frequency of comorbidities. However, this is a well-characterized sample that was large enough to provide insights on significant associations between oral health and HRQoL, a field with scarce data, especially in less-developed settings.

Conclusions
In conclusion, this study found associations between poor oral health (high DMFT index) and Mental Health Component Summary in HIV-infected patients with depression. Lower health-related quality of life and poorer oral health were observed in patients with comorbidities. These findings reinforce that patients with depression should deserve special attention to their HRQoL and oral care.

Availability of data and materials
The patients’ data are not publically available in order to maintain them in strict confidence; however, it may be obtained from corresponding author on reasonable request.

Authors’ contributions
We declare that all authors included in this paper fulfill authorship criteria. LL, VAS, EMN and CB have worked in the conception and design of the study; VCV and VAS have worked on data collection. LL, EMN and CB have performed statistical data analyses and interpretation. LL and VCV have contributed in the last version for publication.

Ethics approval and consent to participate
This study was approved by the Ethics Review Board of the University Hospital Professor Edgard Santos, Federal University of Bahia (protocol number 17404/2018), in accordance with Brazilian National Health Council Resolution 466/2012 and the Declaration of Helsinki. Prior to inclusion in the study, all volunteers signed an informed consent form.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References
1. Brites-Alves C, Netto EM, Brites C. Coinfection by hepatitis C is strongly associated with abnormal CD4+/CD8+ ratio in HIV patients under stable ART in Salvador. Brazil J Immunol Res. 2015;2015:174215.
2. Rodriguez-Penney AT, Ludicello JE, Biggs PK, Doyle K, Ellis RJ, Letendre SL, Grant I, Woods SP. Group HIV/NRP: co-morbidities in persons infected with HIV; increased burden with older age and negative effects on health-related quality of life. AIDS Patient Care STDs. 2013;27:5–16.
3. Ja HG, Uphold CR, Zheng Y, Wu S, Chen GJ, Findley K, Duncan PW. A further investigation of health-related quality of life over time among men with HIV infection in the HAART era. Qual Life Res. 2007;16:961–8.
4. Wu P-Y, Chen M-Y, Hsieh SM, Sun H-Y, Tsai M-S, et al. Comorbidities among the HIV-Infected Patients Aged 40 Years or Older in Taiwan. PLoS ONE. 2014;9(8):e104945.
5. Betancur MN, Lins L, Oliveira IR, Brites C. Quality of life, anxiety and depression in patients with HIV/AIDS who present poor adherence to antiretroviral therapy: a cross-sectional study in Salvador, Brazil. Braz J Infect Dis. 2017;21(5):507–14. https://doi.org/10.1016/j.bjid.2017.04.004. Epub 2017 May 21.
6. Ngurn PA, Fon PN, Nguc RV, Veria VS, Lumia HN. Depression among HIV/AIDS patients on highly active antiretroviral therapy in the southwest regional hospitals of Cameroon: a cross sectional study. Neurol Ther. 2017;6:103–14.
7. Liu CL, Ostrow D, Detels R, Hu Z, Johnson L, Kingsley L, Jacobson LP. Impacts of HIV infection and HAART use on quality of life. Qual Life Res. 2006;15:941–9.
8. Degroote S, Vogelaers D, Vandijck DM. What determines health-related quality of life among people living with HIV: an updated review of the literature. Arch Public Health. 2014;72:40.
9. Uthman OA, Magidson JF, Saffren SA, Nacheja BJ. Depression and adherence to antiretroviral therapy in low-, middle- and high-income countries: a systematic review and meta-analysis. Curr HIV/AIDS Rep. 2014;11:291–307.
10. Campos LN, Guimarães MDC, Remien RH. Anxiety and depression symptoms as risk factors for nonadherence to antiretroviral therapy in Brazil. AIDS Behav. 2010;14(2):289–99.
11. Batavia AS, Secours R, Espinosa P, Jean Juste MA, Severe P, Pape JW, et al. Diagnosis of HIV-associated oral lesions in relation to early versus delayed antiretroviral therapy: results from the CIPRA HT001 trial. PLoS One. 2016;11(3):e0150656. https://doi.org/10.1371/journal.pone.0150656.
12. X-Glick M, Berthold P, Dank J. Severe caries and the use of protease inhibitors. J Dent Res. 1998;77:77–84.
13. Y- Nazaves M, Mulligan R, Barón Y, Redford M, Greenspan D, Alves M, Phelan J. A 4-year longitudinal evaluation of xerostomia and salivary gland hypofunction in the women’s interagency HIV study participants. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002;95:693–8.
14. Z- Bretz WA, Flattz C, Moretti A, Corby T, Schneider LG, Nichols CM. Medication use and dental caries outcome-related variables in HIV/AIDS patients. AIDS Patient Care STDs. 2000;14:549–54.
15. Lins L, Farias E, Brites-Alves C, Torres A, Netto EM, Brites C. Increased expression of CD38 and HLADR in HIV-infected patients with oral lesion. J Med Virol. 2017;89(10):1782–7. https://doi.org/10.1002/jmv.24852. Epub 2017 Jun 15.
16. Mohamed N, Saddiki N, Yusoff A, Jelani MA. Association among oral symptoms, oral health-related quality of life, and health-related quality of life in a sample of adults living with HIV/AIDS in Malaysia. BMC Oral Health. 2017;17:119. Published online 2017 Aug 22. https://doi.org/10.1186/s12903-017-0409-y.
17. Ware JE, SF-36 health survey update. Spine. 2000;25:310–9.
18. World Health Organization. Oral health surveys basic methods. 4th ed. Geneva: WHO; 1997.
19. Leroy E, Eaton KA, Savage A. Methodological issues in epidemiological studies of periodontitis - how can it be improved? BMC Oral Health. 2010;10:8.
20. Landsa JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159–74.
21. Krasse B. Caries risk: a practical guide for assessment and control. Chicago, IL: Quintessence; 1985.
22. Okoro CA, Strine TW, Eke PI, D Singh SS, Balluz LS. The association between depression and anxiety and use of oral health services and tooth loss. Community Dent Oral Epidemiol. 2012;40:134–44.
23. Liberati SA, Coates EA, Freeman AD, Logan RM, Jamieson L, Meija G. Oral conditions and their social impact among HIV dental patients, 18 years on. Aust Dent J. 2013;58(1):18–25.
24. Santo AE, Tagliaferro EP, Ambrosio GM, Meneghim MC, Pereira AC. Dental status of Portuguese HIV+ patients and related variables: a multivariate analysis. Oral Dis. 2010;16(2):176–84.
25. Aleixo RO, Scherma AP, Guimarães G, Cortelli JR, Cortelli SC. DMFT index and oral mucosal lesions associated with HIV infection: cross-sectional study in Porto Velho, Amazonian region - Brazil. Braz J Infect Dis. 2010;14(5):449–56.
26. Soares GB, Garbin CA, Moimaz SA, Garbin AJ. Oral health status of people living with HIV/AIDS attending a specialized service in Brazil. Spec Care Dentist. 2014;34(4):176–84.
27. Pinheiro A, Marcinianes W, Zakrzewska JM, Robinson PG. Dental and oral lesions in HIV infected patients: a study in Brazil. Int Dent J. 2004;54(3):131–7.
28. Saravani S, Zehi TN, Kadeh H, Mir S. Dental Health Status of HIV-Positive Patients and Related Variables in Southeast Iran. Int J High Risk Behav Addict. 2016;5(2):e29149.
29. Schwendicke F, et al. Socioeconomic inequality and caries: a systematic review and meta-analysis. J Dent Res. 2015;94(1):10–8.
30. Khazaei S, Keshetri AH, Feizi A, Savabi O, Adibi P. Epidemiology and risk factors of tooth loss among Iranian adults: findings from a large community-based study. Biomed Res Int. 2013;2013:786462.
31. Jaquet A, et al. Antiretroviral treatment and quality of life in Africans living with HIV: 12-month follow-up in Burkina Faso. J Int AIDS Soc. 2013;16:18867.
32. Fleming CA, Christiansen D, Nunes D, Heeren T, Thornton D, Horsburgh CR, Koziel MJ, Graham C, Craven DE. Health-related quality of life of patients with HIV disease: impact of hepatitis C coinfection. Clin Infect Dis. 2004;38:572–8.