

Dental caries status of children receiving Highly active antiretroviral therapy (HAART) - A multicentric cross-sectional study in Tamil Nadu, India

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ABSTRACT

Background: Highly active antiretroviral therapy (HAART) has progressively improved the life expectancies in HIV positive children. These antiretroviral drugs could possibly have an influence on the oral health status. Different age groups of children under HAART with caries had implications in approach to dental treatment, which were attempted to be identified in the study. **Aims/Objectives:** The aim of the study was to assess the caries status among HIV positive children receiving HAART. To characterize the age group with high caries indices and treatment needs. **Methods:** A cross-sectional study was conducted among 313 HIV infected children aged 3–14 years receiving HAART from various ART centers Tamil Nadu, India. Dental examinations were performed and caries status of primary and permanent dentition was assessed using Decayed, Missing, and Filled teeth (DMFT)/Decayed, Missing, and Filled surface (DMFS) indices. **Statistical Analysis:** The one way ANOVA with post-hoc Tukey HSD test. **Results:** The mean dmft/DMFT scores were $3.15 \pm 2.72/2.07 \pm 1.31$ and defs/DMFS scores were $7.42 \pm 5.90/4.30 \pm 2.58$. The caries incidence was significantly different across the three age groups compared. DMFT scores of 13 – 14 years age group were significantly higher than in the 3–6 years ($P < 0.0000$) and 7–12 years ($P < 0.0001$). **Conclusion:** A higher caries experience was present among children on HAART as compared to the general population in Tamil Nadu. A significant association with increasing age and DMFT scores was noted. Age groups of 13–14 had high caries prevalence than age groups of 3–6 and 7–12 years in given study population. The individualized treatment approaches based on the age groups is suggested.

Keywords: Antiretroviral therapy, children, dental caries, Highly active antiretroviral therapy, HIV

Introduction

Overall, estimates show that 37.9 million people are living with human immunodeficiency virus (HIV) including 1.7 million children under the age of 15.^[1] In India, it is estimated that 21.17 lakhs individuals were diagnosed with HIV and children under the age of 15 accounted for 6.54% in 2015.^[2] Highly

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Received: 31-05-2020

Revised: 09-09-2020

Accepted: 20-09-2020

Published: 31-12-2020

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_1032_20

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How to cite this article: Shanmugavadivel G, Senthil Eagappan AR, Dinesh S, Balatandayoudham A, Sadish M, Kumar PP. Dental caries status of children receiving Highly active antiretroviral therapy (HAART) - A multicentric cross-sectional study in Tamil Nadu, India. J Family Med Prim Care 2020;9:6147-52.

active antiretroviral therapy (HAART) has been extremely successful in managing patients with HIV infection. The recent development of co-formulation of antiretroviral drugs and once-daily regimens reduces morbidity and mortality associated with HIV and improves the quality of life in patients through inhibition of HIV replication.^[3] As of September 2015, nearly 77,729 children living with HIV in India were in active care at antiretroviral therapy (ART) centers and 49,909 were receiving pediatric antiretroviral therapy.^[2]

The maternal-to-child transmission (MTCT) accounts for 90% of children being positive for HIV and ART plays a key role in the prevention of the same.^[4] Oral lesions are the earliest and most frequent clinical sign in HIV positive patients.^[5] Prevalence of oral manifestations among children infected with HIV in developed countries has been reported to be as high as 72%.^[6] The dental literature suggests children diagnosed with HIV are more vulnerable to oral lesions, dry mouth, and dental caries compared to children without HIV. The increased rate of caries has been attributed to prolonged bottle-feeding, immunodeficiency caused by the disease, diet modifications for weight gain, the effect of medication on salivary flow and oral microflora, poor oral hygiene, and low CD₄ count.^[7]

Children with HIV are often treated with antiretroviral therapy. Various authors have well documented the significant decline of incidence of oral manifestations in HIV-infected patients under HAART. In a study, Nicolatou-Galitis *et al.* observed that the incidence of oral lesions, particularly oral candidiasis was significantly reduced in patients subjected to HAART.^[8] Similarly Tappuni AR, *et al.*^[9] and Eweka OM *et al.*^[10] reported significantly fewer oral lesions in patients undergoing ART.

Though several studies have investigated oral lesions among children with HIV infection under HAART, very few studies have been conducted on the caries status among these children. Dental caries can have serious impact on the child's quality of life and can be an additional burden to the family dealing with HIV infection. Meless D, *et al.* have reported of prevalence of caries experience to be 86% among HIV infected children on ART.^[11] But Muraleedharan S, *et al.* have reported lower incidence of dental caries among children undergoing ART.^[12]

Thus studies documenting the caries experience of children under ART are few and the results are mixed. The mean DMFT scores among Indian children is found to be higher as compared to children in other parts of the world.^[13] Studies have reported the prevalence of caries in HIV-infected children as high as 75.9% and that oral health-related impact on quality of life was 69.0% which is quite alarming.^[14] The characterization of caries in children of different age groups is essential as the treatment needs and approach greatly vary with age and psychology of the child. The children with HIV-1 with over 12-years of age reported a frequent oral health-related impact on quality of life.^[14]

There are even fewer studies in India that reported on caries prevalence for children under ART and that we might expect to find a variation of prevalence in dental caries and possibly identify susceptible age group to dictate treatment needed accordingly. Therefore, the present study was conducted to assess the dental caries status in HIV-positive children receiving HAART from ART centers in Tamil Nadu, India. In view of dental caries treatments in HIV children primary health care centers (PHCs) have almost a minimal role in India.^[15] The role of primary care physicians (PCP) in the regard of dental health is imported everlasting and unaddressed issue.

Materials and Methods

This is a cross-sectional study that was carried out for 6 months at the Department of Pedodontics, Rajah Muthiah Dental College & Hospital. The study population consisted of 3 – 14 years old children receiving HAART from ART centers in Tamil Nadu. A total of 313 children were selected from ART centers in Villupuram, Vellore, Thiruvannamalai, Tiruchirappalli, and Salem districts of Tamil Nadu. Children were randomly selected from the five centers through systematic random sampling. Ethical clearance was obtained from Institutional Ethical Committee of Rajah Muthiah Dental College & Hospital [RMDC/IRB/036/2018]. Participation of the subjects in the study was voluntary wherein verbal and written information on the purpose of the study was given to parents/legal guardians of the study participants and written informed consent was obtained (20.3.2018).

Inclusion Criteria were those children with HIV seropositivity, receiving HAART from the ART centers in Villupuram, Vellore, Thiruvannamalai, Tiruchirappalli, and Salem districts of Tamil Nadu, Children receiving ART for a minimum of 6 months and is currently on treatment and children within age group of 3 – 14 years. Exclusion criteria were- Children on medications other than HAART, Children with other systemic disorders, and Children not co-operative for examination.

The methodology involved history taking, examination under adequate illumination in a suitable room at the ART centers. The examination was carried out by a single qualified examiner who was trained and calibrated to ensure uniform evaluation. Caries status in permanent dentition was assessed using DMFT/DMFS indices. For assessing the dental caries in the primary dentition deft and defs indices were used. The examiner followed universal precautions for examination, instrument handling, and sterilization as per stated standards.^[16]

Statistical analysis

The obtained data were computed and analyzed using statistical package SPSS version 21.0 (IBM Inc., Chicago, USA). The descriptive statistics were represented by frequency and percentages. The one way ANOVA with post-hoc Tukey HSD was used to evaluate for significant associations between caries scores and age groups ($p < 0.05$).

Results

The study population comprised of 313 children aged between 3 and 14 years. Of these, 169 (53.99%) were males and 144 (46.01%) were females. The study participants were divided into three groups based on their age: 3 – 6, 7 – 12, and 13 – 14 years. The maximum number of participants (59.75%) were in the age group of 7 to 12 years. 71 subjects (22.68%) were in the age group of 13 to 14 and 55 subjects (17.57%) were in the age group and 3 to 6 years. The distribution of the study participants as per gender and age groups are shown in Table 1.

In the present study, the mean Decayed, Missing, Filled tooth deft was 3.15 ± 2.72 and the mean Decayed, Missing, Filled tooth (DMFT) was 2.07 ± 1.31 . Mean decayed, extracted, filled tooth surfaces (defs) and Decayed, Missing, Filled tooth surfaces (DMFS) scores were 7.42 ± 5.90 defs and 4.30 ± 2.58 , respectively [Table 2].

Table 3 shows the mean caries experience in primary dentition (deft/defs) of the three different age groups. Caries prevalence was maximum in 3 – 6 years age group ($5.29 \pm 2.02/11.93 \pm 4.12$) followed by 7 – 12 years age group ($3.15 \pm 2.68/7.49 \pm 5.82$) and least in 13 – 14 years age group ($1.50 \pm 2.13/3.75 \pm 4.78$). The significance was confirmed with ANOVA, which revealed that the mean deft and defs scores between the age groups were statistically significant ($P < 0.0000$). Post hoc HSD test showed that mean deft and defs score of 3 – 6 years age group was significantly higher ($P < 0.0000$) than the 7 – 12 years and 13 – 14 years. It was also noticed that there was significant difference ($P < 0.0000$) between the scores of 7 – 12 years and 13 – 14 years age groups.

Table 4 shows the mean caries experience in permanent dentition (DMFT/DMFS) of the three different age groups. The mean DMFT/DMFS significantly increased with age from $0.86 \pm 0.66/2.00 \pm 2.04$ in 3 to 6-year-old to $2.14 \pm 1.19/4.56 \pm 2.42$ and $2.81 \pm 1.38/5.38 \pm 2.31$ in 7 – 12 year and 13 – 14 year age group respectively ($P < 0.0000$).

Post hoc HSD test revealed the DMFT scores of 13 – 14 years age group were significantly higher than in the 3 – 6 years ($P < 0.0000$) and 7 – 12 years ($P < 0.0001$). Similarly DMFS scores of 13 – 14 years age group were significantly higher than in the 3 – 6 years ($p < 0.0000$) and 7 – 12 years ($P < 0.032$). The test also showed that DMFT and DMFS scores of 7 – 12 years age group were significantly higher than 3 – 6 years age groups ($P < 0.0000$).

Discussion

In the present study we found a mean deft/DMFT of $3.15/2.07$ which is much higher than the WHO (Oral Health Goals 2010) target of mean DMFT/dmft of 1.5, and the mean deft/DMFT for south India which was reported to be 2.74 for 5 years, 1.28 for 12 years.^[13,17] Thus children on HAART in the current study

Table 1: Age and Gender-wise distribution of study participants

Age group	Male		Female		Total	
	n	%	n	%	n	%
3-6	31	9.90%	24	7.67%	55	17.57%
7-12	105	33.55%	82	26.20%	187	59.75%
13-14	33	10.54%	38	12.14%	71	22.68%
Total	169	53.99%	144	46.01%	313	100%

Table 2: Overall caries experience among study participants (n=313)

	Caries Indices			
	deft	DMFT	defs	DMFS
Mean	3.15	2.07	7.42	4.30
Standard deviation	2.72	1.31	5.90	2.58

Table 3: Comparison of caries experience in primary dentition across different age groups

Age group	n	deft (Mean $\pm$ SD)	defs (Mean $\pm$ SD)
3-6 years	55	5.29 ± 2.02	11.93 ± 4.12
7-12 years	187	3.15 ± 2.68	7.49 ± 5.82
13-14 years	71	1.50 ± 2.13	3.75 ± 4.78
P		0.00005	0.00005

Table 4: Comparison of caries experience in permanent dentition across different age groups

Age group	n	DMFT (Mean $\pm$ SD)	DMFS (Mean $\pm$ SD)
3-6 years	55	0.86 ± 0.66	2.00 ± 2.04
7-12 years	187	2.14 ± 1.19	4.56 ± 2.42
13-14 years	71	2.81 ± 1.38	5.38 ± 2.31
P		0.00005	0.00005

exhibited higher caries experience as compared to the general population. In support to the findings of the current study, higher deft/DMFT findings ($3.2/1.9$) have also been reported by Oliscovicz NF *et al.*, in a study conducted on HIV-infected children aged 2 – 16 years undergoing HAART in Brazil.^[18] The results are also in consonance with the findings reported by Beena J.P in a study conducted on 2 – 14 years old HIV positive children undergoing ART in Bangalore, India.^[19] They had reported a comparable mean deft of 5.07 and 3.81 in the primary dentition group (2 – 6 years) and mixed dentition group (7 – 12 years) respectively, in addition, to mean DMFT of 3.00 in the permanent dentition group (children >12 years).

Similarly, Rwenyony CM, *et al.*^[20] have reported Ugandan children on HAART to have a higher frequency of dental caries as compared to their counterparts, not on HAART and Malele Kolisa Y, *et al.*^[21] presented with similar findings as ours in adolescents living with HIV in Johannesburg, South Africa.

However lower caries scores have been reported on a single study by Muraleedharan S, *et al.*, on HIV-seropositive children

undergoing ART in Mangaluru, South India (mean DMFT/dmft of $1.11 \pm 1.94/1.31 \pm 2.04$). And they have attributed the lower scores to better knowledge and awareness of oral hygiene practices.^[12]

The reason for the higher caries experience among children on HAART in the present study could be attributed to the ART medications. ART medications are available in the form of suspension, syrup, and solutions and tablets to be administered orally. These drugs are very unpleasant, that it is difficult to get the child to consume them. Hence to make these drugs palatable, high amounts of sugar with flavoring agents are added. The sugar content can become fermented by the oral bacteria, which can bring down the intraoral pH leading to dental caries. These drugs can also result in reduction in salivary secretions. When these drugs are given over prolonged periods several times a day, they have detrimental effects on dental health.^[22] Nittayananta W, *et al.*, have reported the adverse effect of HAART on salivary gland function and decreased salivary flow with long term use of HAART.^[23] Hypofunction of the salivary gland and decreased salivary secretion (Xerostomia) increase the risk of dental caries. Decreased immune-competence is the other important factor that influences the occurrence of dental caries.^[24]

Children in the current study exhibited an increase in the caries in the permanent dentition with increasing age, similar to the findings of Rwenyony CM, *et al.*^[20] This could be attributed to the cumulative effect of the disease. Children also exhibited a decrease in caries in the deciduous dentition with increasing age; this was an expected finding as the number of deciduous teeth reduces with increasing age.

Age is an important factor when the prevalence of caries in HIV infected children is to be reported. The study results showed higher prevalence in age groups of 13 – 14 years which is almost line with a similar study. Dental caries in HIV-1 children were almost 75.9% prevalent and are reported to cause oral health-related impact on quality of life in 91.7% in those aged between 11 and 14 years age group.^[14] The DMFS scores of 13 – 14 years age group were significantly higher than other groups and in line with the above study. The children with HIV infection with over 12-years of age reported a frequent oral health-related impact on quality of life^[14] the same group where in maximal prevalence was reported in the current study.

The importance of identifying the age groups as done in our study is that children of different age groups may need different treatment approaches. The 3 – 6 years age group had highest caries scores for primary dentition. In such cases, parent/caregiver counseling (diet and hygiene-related) and treatments with behavior counseling may be needed. The children with high caries must be identified as they are reported to have issues like inability to bite food, toothache leading to missing school, and overall low quality of life.^[25]

The behavioral modifications and psychological support is needed in age groups around 12 years prior to definitive dental treatment. This is because, the children in the age group of 11 – 14 tend

to develop social relationships, gain self-awareness, take concern on the appearance of teeth and face and reason implications of these in social acceptance.^[26] Thus, overall psychological support is needed in age groups prior to definitive dental treatment. Thus, it is the role of the pediatric dentist or primary care providers to create awareness among psychologists/psychiatrists, pediatricians, oncologists, parents, and children with HIV about the effects of medication on dental health, and promote good dental hygiene.

Routine dental camps and checkups must identify and treat caries at an early stage for children under HAART. In addition, fluoride varnishes and pit and fissure sealants may be recommended when ART caused hypo-salivation or related issues. Patients must be followed up at regular intervals by a pediatric dentist in order to monitor the dental status and identify caries at the earliest and thus prevent long-term dental problems and improve the overall quality of life. The general HIV treatment recommendations like dietary caries preventive measures, oral hygiene habits, adherence to ART/HAART regimes are utmost essential along with regular dental checkups in the management of HIV-infected children. This is part of primary health care and primary care centers (PHC), the initial point of contact in our health care system.

Primary care physicians (PCPs) are community-based primary care medical providers who also play an important role in providing access to preventive dental services, particularly for preschool children. The role of PCPs in dental caries referral is established in research and specialists in dental public health and pediatric/preventive dentistry have role in the initial screening and counseling that were traditionally given to prevent dental caries in children in some countries.^[27] The physician—dentist collaborative efforts in the prevention of dental caries are highlighted as an issue to be addressed in the USA.^[28] with guidelines published by National Academy of Medicine, Washington, USA in 2018.^[29] In spite of this evidence, the screening of dental caries was needed for medically alert groups (Ex: Congenital cardiac diseases), the regulations for PCP-Dentist based interventions do not exist in India. A systematic review in 2020 had concluded that HIV-positive children care program should be conducted with dental protocols, as oral disease occurring in HIV negatively influences the quality of life, affecting both functional and social aspects.^[30] A review of epidemiological studies conducted in Southern India suggested that the prevalence of dental caries at the age of 12 years ranging from 37 to 69%. Considering from the point of primary care provision, the state dentist to population ratio was 1:2200 recruiting only 2% of dentists as government sector task force. This had led to the absence of oral care in first contact levels like primary health centers and leaving almost a marginal chance for medially alert children being referred to treatment needs.^[15] Thus, recruitment of doctors, improvement of dental care settings in PHCs, PCP-dentists collaborative efforts, and referrals of HIV children for comprehensive treatment is highly needed for overall management of highly prevalent caries in HIV children.

Summary of key points

1. High prevalence of dental caries in HIV positive children in southern India with a significant association with increasing age and DMFT scores.
2. The age groups of 3-6 (primary dentition) and 13-14 (permanent dentition) had high dental caries prevalence in children on HAART.
3. The important aspect in management of HIV infected children with caries involves behavioral counseling and specific dental interventions which highly differ with respect to age of children.
4. There is a need of attention regarding dental settings in primary care systems in India. The PCP-dentist referrals/collaborations and access of dental treatments in PHCs is very minimally reported to occur.

Conclusion

A higher caries experience was present among children on HAART as compared to the general population in Tamil Nadu. A significant association with increasing age and DMFT/deft scores was noted. Age groups of 3-6 (primary dentition) and 13-14 (permanent dentition) had high caries prevalence; each of which needing different treatment approach as suggested. Primary care provision for dental caries in HIV children is issue needing attention in India.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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