

## Co-relation between ART (Anti-Retroviral Therapy) Adherence with Nutritional Status and Quality of Life among HIV-Infected Adolescents

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### Abstract

*Successful treatment for Perinatally Infected Adolescents (PIA) faces physical challenges like the risk of co-morbidity, deferred growth, and development, often resulting in late puberty in girls, and stunting/wasting makes it difficult to reach the transition phase of adulthood. The study aims to identify the correlation between ART adherence with nutritional status and QOL and find the association between adherence scores with selected demographic variables among adolescents. A randomized Controlled Trial design was adopted. Through simple random technique, a total of 388 HIV-infected adolescents were divided into experimental (195) and control (193) groups. The data were collected from four ART clinics in Chennai, India, through standardized ART adherence, QOL, and structured nutritional assessment questionnaires. Motivational counselling was given to the experimental group, and the researcher demonstrated selected asanas. The data were collected from both groups at '0', '3' & 6-month intervals. Descriptive & inferential statistics were used for the analysis of data. Regarding correlation, in the experimental group, baseline assessment showed poor correlation, but in the 3<sup>rd</sup> & 6<sup>th</sup> months there was a fair and moderate correlation found and was significant at  $p=0.05^{**}$  and  $P=0.001^{***}$  respectively. Whereas in a control group, throughout the assessment period showed that, there was a poor correlation. Regarding association, showed adolescents' age, sex, sex of caregivers, relationship with adolescents, and residence were found significant. Motivational counseling along with asana has a positive correlation to ART adherence to promote the health and well-being of adolescents in the experimental group than in the control group.*

**Keywords:** *Adherence, Correlation, HIV-infected adolescents, Nutrition, Quality of life.*

### Introduction

The epidemic disease of HIV/AIDS affects adolescents in two ways: i.e., Perinatally Infected Adolescents (PIA) through vertical transmission of mother to child and Behaviorally Infected Adolescents (BIA) usually through sexual transmission [1]. The trademark of HIV infection is progressive CD4 + T cell reduction causing an augmented risk for the evolution of Opportunistic Infections (OIs), AIDS, and death. HIV-infected children and adolescents have prominent viral loads and are at risk for the rapid progress of disease due to poor development of

the immune system [2] Even though the Highly Active Anti-Retroviral Therapy (HAART) treatment for HIV infection is a lifelong commitment for all People living with HIV/AIDS (PLHIV) but more challenging for Adolescents living with HIV (ALHIV) to take from childhood period. The booming adherence to HARRT results in virologic repression, a boost in the CD4 count + T cells, and enhancement in the clinical well-being of the individual evidenced by the weight gain and control of OIs [3].

The optimal adherence (>95%) to ART is the main significant indicator to restrain HIV

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imitation and to shun the emergence of drug resistance. Optimal adherence is a major requirement for the efficacy and stability of ART and keeping an adolescent on a first line (1 NNRTI + 2 NRTI) as long as possible. Once the first-line regimen had fewer improvements in therapeutic outcomes due to non-adherence or poor retention in care or loss of follow-up the increased viral load and progress of the disease turns into the next choice of the second-line regimen (1 PI + 2 NRTI) [4]. The optimal level of more than 95% drug adherence is essential and associated with improved Clinical, Immunological, and Virological outcomes [4,5]. Adolescents and young people represent a growing share of people living with HIV worldwide. In 2020, 410,000 young people between the ages of 10 to 24 were newly infected with HIV, of whom 150,000 were adolescents between the ages of 10 and 19. To compound this, most recent data indicates that only 25 % of adolescent girls and 17 % of adolescent boys aged 15-19 in Eastern and Southern Africa region. Additionally, a large population of children infected with HIV perinatally over the last decade growing into adolescence [6]

Perinatal HIV-infected adolescents have correlated with malnutrition, underweight, low weight gain, and delay in sexual maturity due to disease progression as well as the side effects of ART medications including lipo dystrophy, anaemia, nausea, dizziness, memory loss, inability to sleep, rashes, weakness, and lower self-esteem other symptoms [1,7]. The side effects are the biggest barriers between ALHIV and other children. It is because of the side effects that ALHIV develop internalized stigma, and then it becomes difficult to address their issues. The poor and malnutrition are often cited as the main reason for the low weight gain and delay in the inception of puberty in Indian adolescents [8]. The nutritional requirements are higher among adolescents than in any other stage of life. The imbalanced and inadequate diet intake at this age progress to stunted growth and deferred sexual maturation. Antioxidants are

substances that restrain oxidation and sentinel the body from the detrimental effects of free radicals which play a vital role in scavenging excess Reactive oxygen species (ROS) to sustain normal physiological conditions. The combination of antioxidants and HAART lower the viral loads and the generation of ROS from antiretroviral (ARV) treatment. Hence on a global scale, it is presumed that antioxidant management may offer a cost-effective therapeutic approach for ALHIV & PLHIV [9].

The HIV-Health Related Quality of Life (HRQOL) may be a primary measure of management and care programs for BIAs and young adults because of the unique stress experienced during this stage of cognitive and sexual development. Further, BIAs have raised concerns over stigma compared with PIAs, and challenges in coping with the physical and social aspects. However, the stigma may impact depression and social support from society for both categories of adolescents. The PIAs had lower QOL when compared to the other age groups because of the long-term management of life-saving drugs of ART with pill burden and its side effects [10,11]. The estimated range from 22% to 38% of the prevalence of depression was noticed in HIV-infected adolescents. The management of depression in HIV/AIDS may not extend life but can reduce the risk of suicide progress the QOL and improve life even with a complex ART regimen [12]. A cross-sectional study of HIV-infected children in Thailand revealed that a significant correlation was found between physical functioning, symptoms, health care utility, and social role functioning [13]. Modifiable factors like ART regimen and nutrition are strongly associated with survival and improve the QOL of HIV-infected people. Apart from this, in order to improve the QOL of children/adolescents they need good physical and mental health essential for enhancing the various physiological dimensions of growth and development [11].

Today yoga has become popular in therapeutic practice; stress reduction in people

with HIV can contribute to longevity and improve health. Regular yoga practices along with adherence to the HART regimen led to enhanced well-being with less burden to society for PLHIV. The regular practice of yoga will promote health, develop positive attitudes and health practices, and improve self-confidence ALHIV which prevents HIV transmission in the future [14]. The results showed in [15] a considerable reduction in depression scores ( $F = 4.19$ ,  $P < 0.05$ ), and a significant increase in CD4 counts in the yoga group. However, in the control group, there was a non-significant rise in anxiety and depression scores. It concluded that the regular one-month practice of IY can reduce depression and improve immunity in HIV-1 infected participants [15]. The overall goal of optimal level of adherence to ART is to reduce HIV/AIDS morbidity and mortality by 60–90% and to prolong the quality to reduced survival of life of all ALHIV. Hence, a multi-disciplinary approach towards ALHIV is essential and especially needs to focus on optimal adherence to ART to achieve the global target of 90-90-90. The health professionals are involved in the care of the children and adolescents through counselling, knowledge will aid in effectively interpreting the factors involved in sustained adherence and helps to define the nutritional status and improve QOL and outcome of HIV-infected children. [16].

Therefore, the investigator aimed to give attention to the adolescents, whether correlation ART adherence with nutritional status and QOL in terms of improving immunity, weight gain, management of symptoms, and safe & healthy behaviors abets to reduce the morbidity and mortality related to HIV/AIDS. Hence, this study focused on the following objectives of; identify the correlation between ART adherence with nutritional status and QOL among HIV-Infected Adolescents. and to find the association between posttest adherence gain score with selected demographic variables among HIV-infected adolescents/caregivers in experimental and control groups.

## Hypotheses

1. There is no correlation between ART Adherence with Nutritional Status and Quality of Life among HIV-Infected Adolescents in experimental and control groups.
2. There is no association between posttest adherence gain score with selected demographic variables of HIV-infected adolescents/Caregivers in experimental and control groups.

## Materials and Methods

The research design of a Randomized Controlled Trial was adopted. Through simple random technique, 388 HIV-infected adolescents were selected from four ART centers in Chennai, Tamil Nadu, India. The samples aged 10 to 17 years and on ART for more than 3 months attending the ART Clinic were included and IV clinical stage of HIV/AIDS, hospitalized and physical and mentally challenged HIV-infected adolescents were excluded. The study instruments consisted of the following four parts. They are,

## Tools Description

1. **Demographic Questionnaire:** It includes the characteristics of HIV-infected adolescents/caregivers and background information of HIV-infected adolescents.
2. **Adherence Assessment Questionnaire:** (AIDS Clinical Trial Group -ACTG No: QL0757(000)/00-00-00), and the Pill count method was used. It was interpreted as, 95%-100% = optimal, 80%-95% = suboptimal, and < 80% = poor adherence.
3. **Nutritional Assessment Questionnaire:** It collects all anthropometric variables based on the National Centre on Health Statistics and WHO standards to assess malnutrition. Based on the 'Z' score, it was interpreted as Z score < 2.0 normal, 3.0 < Z score < - 2.0 moderately malnourished, and severely malnourished Z score < - 3.

4. **QOL Assessment-Revised Questionnaire** (ACTG 5-11 years No: QL4004(000)/00-00-00 and 12-20 years No: QL4005(000)/00-00-00): It includes QOL in the areas of general health ratings, physical functioning, psychological wellbeing, social role functioning, health care services, and symptom distress management. The QOL maximum score was 338, and the minimum score was 71. Based on the highest score level, it was interpreted as 76-100% = good, 51-75% = moderate, and 0-50% poor QOL.

The tool was validated for its content by a panel of 15 experts from various fields of Nursing, Medicine, Nutrition, and the Alternative Medicine Department. The reliability of the tool was assessed by using the Cronbach alpha method and inter-rater method. In the present study, correlation coefficient 'r' values for the following tools were, ART adherence was 0.87, nutritional status was 0.90 and QOL was 0.88. It showed that the correlation of coefficient value is very high, and the internal consistency of the tool was reliable to execute the main study.

#### **Data Collection Procedure**

Formal permission was obtained from the National AIDS Control Organization (NACO) and the Tamil Nadu AIDS Control Society (TANSAC). The ethical approval was obtained from Madras Medical College and Hospital (No:30102013) Chennai and the study was registered in clinical Trial Registration (CTRI/2015/02/005521). After getting the informed consent and assent form the pertinent data was collected from the caregivers/adolescents through an in-depth structured interview method and observation of hospital records. The adherence assessment and QOL assessment were collected with the necessary questionnaire and the assessment of nutritional status was taken by anthropometric measurements. The initial assessment score was taken as a pretest or baseline value at '0' per month. On the same day, the experimental group

had counseling sessions on adherence improvement, increased nutritional status, and strategies to enhance the QOL. The selected asanas of Padmasana, Vajrasana, Trikonasana, Ardhamatsyendrasana, Ushtrasana, Bhujangasana, Shavasana & Pranayama were demonstrated by the researcher and instructed to do re-demonstration by study subjects. They were also given brochures for practicing the selected asana every day for a minimum of 15-20 minutes on their own at home. The investigator had been given a diary for interventional aid to improve adherence and instructed to maintain daily after the drug intake and yoga practice.

The investigator gave special attention to a few adolescents who had to learn difficulties in practicing the asana. For these adolescents, the investigator had given an extra time of 15 minutes for a maximum to learn the asana on the same day itself i.e., the total time taken for each sample was 45 minutes to 1 hour. Every month when the subjects came for the pharmacy refill, the investigator monitored the diary and continued interventions such as reinforcement counseling and demonstration of the asana. The interventions were given to the study group for up to 6 months, however in the control group subjects were in routine care as conventional management. The effect of the interventions was assessed at 3<sup>rd</sup> & 6<sup>th</sup>-month intervals by collecting required data from the caregivers and adolescents in both groups at the same intervals. The cursory instructions were given to the control group at the end of the 6<sup>th</sup> month. The collected data were analyzed by descriptive and inferential statistics.

#### **Results and Analysis**

The demographic variables of HIV-infected adolescents in the experimental and control groups showed that the mean age of the study group adolescents was  $13.6 \pm 2.2$  years, and the control group was  $13.8 \pm 2.4$  years. In gender wise the majority 97 and 109 were males. Regarding the educational status, the majority of

77 and 85 were in the middle level of education, and considering the religious aspect, the majority of more than 75% belonged to Hindu in both groups. Whereas the mean age of the caregivers was  $44.3 \pm 13.5$  years, and the control group was  $45.5 \pm 12.2$  years. In gender-wise majority 136 and 128 were females. Regarding the relationship of adolescents 61% and 66% of children were taken care of by caregivers and 27% and 22% by mothers and, nearly 12% by fathers in both groups. Regarding educational status, nearly 50% of them completed the school level of education, and 30% and 24% completed the college level of education respectively in both groups. In consideration of occupational status, the majority of 44% and 49% respectively in both groups were employed. Most of the participants i.e., 42% and 40% were living in the nongovernment organization since the annual income was not an applicable category. Regarding residence, nearly half of the participants, 55% & 53%, resided in urban areas corresponding to both groups.

### **Regarding Adherence Status**

The pill count method was highly correlated with missed dose history in both groups. In the baseline assessment, the mean ART adherence score in the pretest was 85.36, and the post-test score 98.74. The mean difference in ART score with 95% CI (Confidence Interval) was 13.38. However, in the control group, the mean ART adherence score in the pretest was 85.60 and the post-test score was 90.54. The reasons for the non-adherence to ART includes forgetting (33% vs. 40%) boring (6% vs. 5%), being busy scheduled (10% vs. 7%) traveling (7% vs. 9%) and not having finance to come and collect the drugs (2% vs. 1%) and adverse effects of drugs (1% vs. 0.5%) respectively in both groups. But after intervention in the experimental group still 6% of adolescents had problems because of forgetting. Whereas in the control group, there was no significant reduction noted. These findings depicted that the motivational counseling and interventional diary has the

effectiveness to increase the adherence to ART among HIV infected adolescents in experimental group (13.4%) than the control group (4.9%). Regarding the CD4 count, in baseline assessment, the mean score was 664.86 in experimental group and 669.72 in control group. Whereas in the 6<sup>th</sup> month assessment of mean score in the experimental and control group was 840.30 and 703.35 respectively. It depicted that there is a statistically significant improvement in CD4 count in experimental group than the control group.

### **Regarding Nutritional Status**

Based on 'Z' score on HIV infected adolescents, in experimental group, 7% were severely malnourished and 22% moderately malnourished in baseline assessment whereas in the 6<sup>th</sup> month evaluation it reduced to 1% and 18% respectively. The chi square value of 9.48 was significant at  $p=0.05^*$ . However, in the control group, there was no significant improvement from baseline to 6<sup>th</sup> month evaluation. The chi-square value of 0.10 was not significant at  $p=0.99$ . It depicted that; the experimental group has gained more scores when compared to the control group. **Regarding Quality of Life**, in the experimental group, the mean QOL score in baseline was 163.66 and 6<sup>th</sup> month was 215.64. The mean difference in ART score with 95% CI was 51.97. However, in the control group, the mean QOL score in baseline was 162.93 and 6<sup>th</sup> month was 166.02. The mean difference in ART score with 95% CI was 3.09. It denoted that there is a marked improvement in the QOL of HIV-infected adolescents in the experimental group than the control group.

### **Regarding Correlation**

Table 1 shows the correlation between ART adherence with nutritional status and QOL of HIV-infected adolescents in both groups. In the experimental group, the baseline assessment showed that there was a poor correlation between ART adherence and nutritional score. But in, the 3<sup>rd</sup> month there was a air correlation

between ART adherence and nutritional score since  $r=0.31$  significant at  $p=0.01^{**}$  and in the 6<sup>th</sup> month, there was a moderate correlation between ART adherence and nutritional score since  $r=0.42$  significant at  $p=0.001^{***}$ . In the QOL variable, in the experimental group, the baseline assessment shows that there was a poor correlation between ART and QOL score. But in, the 3<sup>rd</sup> month there was a fair correlation between ART and QOL score since  $r=0.31$  significant at  $p=0.05^{**}$  and in the 6<sup>th</sup> month, there was a moderate correlation between ART and QOL score since  $r=0.43$  significant at  $p=0.001^{***}$ . Whereas in the control group, throughout the assessment period shows that there was a poor correlation between ART adherence with nutritional & QOL scores since of 'r' value is lesser than 0.2.

Table 2 shows the association between the ART adherence gain score with demographic variables HIV-infected adolescents/caregivers in the experimental group. In that, the age and sex of adolescents, the caregiver's age, sex, relationship with adolescents, and residence

variables showed significant association with adherence gain score. Regarding age and sex of adolescents, the younger age of 10-12 years and males gained high scores of 15.89 and 14.71 and it is significant at the  $p\leq 0.05^*$  and  $0.03^*$ . In consideration, of the caregiver's age and sex, the younger age of 20-35 years and females gained high scores of 15.99 and 14.83 are significant at  $p\leq 0.05^*$ . Regarding relationships with adolescents and residential areas, the high gain score of 17.48 and 14.99 is seen with mothers and adolescents residing in rural areas. It is significant at  $p\leq 0.04^*$  and  $0.05^*$  respectively. The rest of the other demographic variables are not associated with adherence gain score. Table 3 shows the association between the ART adherence gain score with demographic variables of HIV-infected adolescents/caregivers in the control group. The gain score difference is not significant in the one-way analysis of variance F-test and student-independent test. Here none of the variables are significant with adherence gain score.

**Table 1.** Correlation between ART Adherence with Nutritional and QOL Scores of HIV-Infected Adolescents in both Groups

Groups	Assessment	Karl Pearson correlation coefficient		Interpretation
		Nutritional status	QOL	
Experimental	Baseline	$r = 0.17$	$r = 0.17$	There is a poor correlation between ART with Nutritional & QOL score
		$p = 0.26$	$p = 0.26$	
	3 <sup>rd</sup> month	$r = 0.31$	$r = 0.31$	There is a <b>Fair correlation</b> between ART with Nutritional & QOL score
		$p = 0.01^{**}$	$p = 0.05^*$	
	6 <sup>th</sup> month	$r = 0.42$	$r = 0.43$	There is a <b>Moderate correlation</b> between ART with Nutritional & QOL
		$p = 0.001^{***}$	$p = 0.001^{***}$	
Control	Baseline	$r = 0.16$	$r = 0.16$	There is a poor correlation between ART with Nutritional & QOL
		$p = 0.28$	$p = 0.28$	
	3 <sup>rd</sup> month	$r = 0.17$	$r = 0.18$	There is a poor correlation between ART with Nutritional & QOL
		$p = 0.25$	$p = 0.25$	
	6 <sup>th</sup> month	$r = 0.19$	$r = 0.20$	There is a poor correlation between ART with Nutritional & QOL score
		$p = 0.22$	$p = 0.22$	

**Table 2.** Association between the ART Adherence Gain Score with Demographic Variables of HIV Infected Adolescents/Caregivers in Experimental Group N=195

S. No.	Demographic variables	No.	ART Adherence Gain Score						One way ANOVA/ t-test
			Pretest		Posttest		Gain score (Post - Pre test score)		
			Mean	SD	Mean	SD	Mean	SD	
1.	Age of adolescents	60	82.84	10.75	97.73	2.74	15.89	9.09	<b>F=3.02/P=0.05* S</b>
			86.42	9.26	99.67	1.26	13.25	9.15	
			85.88	10.21	98.63	2.80	11.45	9.95	
2.	Sex	97	84.31	10.48	99.02	2.24	14.71	9.77	<b>t=2.13/P=0.03* S</b>
			85.41	9.76	97.47	2.73	12.06	9.35	
3.	Education	44	86.93	9.95	99.55	1.81	12.61	8.99	<b>F=0.24/P=0.87 NS</b>
			84.94	10.24	98.83	2.68	13.90	9.75	
			85.17	10.17	98.22	2.59	13.05	9.83	
			83.67	9.90	98.00	2.54	14.33	9.61	
			84.73	10.20	98.52	2.66	13.79	9.63	
4.	Religion	26	89.42	8.29	100.00	.00	10.58	8.29	<b>F=1.33/P=0.26 NS</b>
			85.00	12.91	100.00	.00	15.00	12.91	
			84.11	10.71	100.10	2.79	15.99	9.35	
5.	Age of caregivers	136	85.11	10.71	98.35	2.79	13.24	9.17	<b>F=3.06/P=0.05* S</b>
			88.50	13.34	98.50	2.42	10.00	10.30	
			85.11	10.28	97.15	2.73	12.04	9.84	
6.	Sex	136	85.93	9.71	100.76	1.57	14.83	8.89	<b>t=1.98/P=0.05* S</b>
			85.00	10.62	98.15	2.83	13.15	9.98	
7.	Relationship with adolescents	52	82.75	8.88	100.23	2.04	17.48	7.89	<b>F=2.04 / P=0.04* S</b>
			86.92	9.35	98.01	1.18	11.09	9.20	
			87.37	10.95	99.47	1.94	12.11	10.11	
8.	Education	97	84.74	10.22	98.97	2.16	14.23	9.69	<b>F=0.81/P=0.44 NS</b>
			85.08	9.32	97.92	3.09	12.83	8.94	

9	<b>Occupation</b>	Employed	85	87.24	9.90	99.65	1.50	12.41	9.37	F=1.09 / P=0.33 NS
		Not Employed	28	82.14	10.67	97.50	3.47	15.36	10.80	
		Not applicable	82	84.51	9.83	98.23	2.65	13.72	9.26	
10.	<b>Annual income</b>	< Rs.12000	31	83.87	11.95	97.42	3.62	13.55	11.12	F=0.17/ p=0.91 NS
		Rs.12000 -24000	70	86.50	9.94	99.71	1.17	13.21	9.67	
		> Rs.24000	12	88.33	6.85	100.00	.00	11.67	6.85	
		Not applicable	82	84.51	9.83	98.23	2.65	13.72	9.26	
11.	<b>Residence</b>	Rural	88	86.14	9.67	101.06	1.56	14.92	9.05	t=1.97/P=0.05* S
		Urban	107	85.82	10.43	98.04	2.89	12.22	9.98	

S-Significant, NS –Not significant

**Table 3.** Association between the ART Adherence Gain Score with Demographic Variables of HIV Infected Adolescents/Caregivers in Control Group

S.No	Demographic variables	No.	ART adherence gain score						One way ANOVA/t-test		
			Pretest		Posttest		Gain score Post test-Pre test score		Mean	SD	
			Mean	SD	Mean	SD	Mean	SD			
1.	<b>Age of adolescent</b>										
		68	86.03	9.87	89.56	7.21	3.53	11.94			F=0.70 / P=0.49 NS
		78	84.62	9.07	90.26	6.97	5.64	11.99			
		47	86.60	10.53	92.45	5.30	5.85	13.20			
2.	<b>Sex</b>										
		109	84.68	9.98	89.40	6.93	4.72	13.09			t=0.28 / P=0.77 NS
		84	86.79	9.27	92.02	6.26	5.24	11.16			
3.	<b>Education</b>										
		43	86.86	9.20	88.84	6.71	1.98	11.24			F=1.43 / P=0.28 NS
		85	84.71	9.74	90.47	7.26	5.76	12.64			
		50	86.80	8.85	91.80	5.60	5.00	10.35			
		15	83.00	13.20	91.67	6.99	8.67	17.37			
4.	<b>Religion</b>										
		148	86.42	9.49	90.44	6.70	4.02	12.03			F=1.08 / P=0.33 NS
		36	82.92	10.65	88.36	5.79	5.44	13.30			
		9	82.78	7.55	85.00	8.66	2.22	9.55			
5.	<b>Age of caregiver</b>										
		49	86.33	11.12	88.37	7.53	2.04	13.88			F=1.81 / P=0.15 NS



		36 -50 years	125	86.12	9.00	91.40	6.37	5.28	11.31	
		> 50 years	19	84.26	9.20	90.53	6.21	6.26	12.41	
6.	<b>Sex</b>	Male	65	84.46	10.39	91.00	5.94	6.54	12.68	t=1.28 / P=0.20 NS
		Female	128	86.17	9.34	90.31	7.15	4.14	12.01	
7.	<b>Relationship with adolescents</b>	Father	22	87.27	9.73	92.05	6.48	4.77	10.96	F=0.96 / P=0.38 NS
		Mother	43	85.47	11.69	92.67	6.93	7.21	13.02	
		Caregiver	128	85.35	9.01	89.57	6.58	4.22	12.21	
8.	<b>Education</b>	No formal education	53	86.79	10.15	89.81	6.86	3.02	13.10	F=1.10 / P=0.33 NS
		School level	94	85.53	9.05	91.17	7.20	5.64	11.48	
		College level	46	84.35	10.52	90.11	5.63	5.76	12.82	
9.	<b>Occupation</b>	Employed	94	86.91	9.01	89.31	7.17	2.39	11.59	F=0.90 / P=0.41 NS
		Not Employed	21	87.86	10.44	93.10	6.80	5.24	9.15	
		Not applicable	78	84.40	10.02	91.35	5.96	6.95	13.18	
10.	<b>Annual income</b>	< Rs.12000	25	87.20	8.67	87.20	5.02	.00	10.99	F=1.99 / P=0.11 NS
		Rs.12000 -24000	83	85.54	9.78	90.18	7.55	4.64	12.68	
		> Rs.24000	7	90.00	11.55	97.14	3.93	7.14	10.75	
		Not applicable	78	84.74	9.80	91.41	5.97	6.67	12.05	
11.	<b>Residence</b>	Rural	90	86.89	8.20	90.44	6.16	3.56	10.97	t=1.48 / P=0.14 NS
		Urban	103	84.47	10.78	90.63	7.27	6.17	13.21	

S-Significant, NS –Not significant

## Discussion

Young people are our future as well as the world's greatest resource. But the HIV epidemic brought a terrible toll on adolescents and youth have become increasingly vulnerable to transmit and acquire HIV infection. The paradigm of HIV prevention has moved to treatment as prevention strategies, it is essential to identify factors like adherence promotion and retention in care to antiretroviral regimens; promoting nutritional status among HIV-positive adolescents and youth [17] Cardoso C.A. (2012) found the majority (80%) of adolescents had HIV vertically than behaviorally infected adolescents aged 0-19 years old. This study also observed that significant improvement in patients' survival times and a reduction in the number of deaths among patients using HAART [18] Considering with stage of adolescence, most of the participants (71% & 65%) were in stage I, and the majority of 67% and 72% were on ART between 1-5 years The mean age of HIV-infected adolescents in the experimental group adolescents was  $13.6 \pm 2.2$  years and the control group was  $13.8 \pm 2.4$  years. Whereas the mean age of the caregivers was  $44.3 \pm 13.5$  years, and the control group was  $45.5 \pm 12.2$  years. Nearly more than 50% of adolescents (55% Vs. 58%) were diagnosed with HIV status before 5-10 years and 97% and 98% got the HIV infection through mother-to-child transmission respectively in both groups.

Regarding CD4 count before the start of ART, the majority of the adolescents in both groups were below 300 cells/mm<sup>3</sup> of all the age groups. Once they started the ART it was increased but sustained up to 900 cells/mm<sup>3</sup> for the majority (81-86%) of adolescents and only 10% in above 900 cells/mm<sup>3</sup> even after 5 years of ART in both groups. A similar finding was seen in a retrospective analysis of young adolescents in Kenya, i.e., the median CD4 count was 332 cells/mm<sup>3</sup> and the majority were in WHO stage I/II [19] The other study also reported similar results i.e., the median CD4 count was 385

cells/mm<sup>3</sup> (247-555), and a high rate of sub-optimal adherence was observed in all the prenatally infected adolescents [20]. But in the present study, after intervention, there was marked improvement in the experimental group i.e., nearly 15% was increased above 900 cells/mm<sup>3</sup> and the majority (61%) were in 600-900 cells/whereas in the control group there was no significant improvement noted. The increased CD4 count mean difference was only 4.86 in the control group whereas in the experimental group 136.96 in the 6<sup>th</sup> month and proved with student independent test score of 6.67 was significant at  $p=0.001***$ . A similar article [21] also stated that reinforcement counselling regarding adherence improvement, nutritional intervention trials, and exercise programs can be successful in promoting the health outcomes of PLHIV, especially in increasing CD4 count, improving the body composition and reducing the risk of cardiovascular diseases and diabetes [21].

Regarding the correlation of ART adherence level with nutritional status and quality of life in HIV-infected adolescents, in the experimental group, in the 3<sup>rd</sup> and the 6<sup>th</sup>-month evaluation, there was a fair and moderate correlation between ART with nutritional & QOL score. It's depicted that adherence and nutrition are directly propositional. The finding revealed that there is a positive correlation between the adherence and nutritional level of the HIV-infected adolescents in the experimental group. Hence, hypothesis H01 stated that there is no correlation between ART Adherence with Nutritional Status and Quality of Life among HIV-Infected Adolescents in experimental and control groups was rejected. Similar findings were supported by [22] evidenced in their study after the beginning of ART resulted in significant improvement in the mean standardized weight-for-age Z-score ( $P < 0.001$ ), and the height-for-age and Z-score ( $P < 0.05$ ). The study findings found that weight gain was more rapid than height after initiation of ART [22]. Identified the association between the adherence and VL relationship among adolescents with Medication Event

Monitoring System (MEMS) with diaries. 273 HIV-infected adolescents on ARV treatment were monitored with MEMS for 30 days preceding a VL measurement. The adherence was highly associated with VL and improved nutritional status (OR 1.05,  $p < 0.001$ ) [23].

The study conducted in Chennai and Madurai revealed that among 231 HIV-infected children, the prevalence of underweight was 63%, stunting with anaemia at 58%, wasting at 16%, and overall, 33–45% were moderately or severely malnourished even at CD4  $>25\%$ . The height & weight for age Z scores and weight for height were highly associated with CD4 cell counts. The results found that undernutrition and stunting are common among HIV-infected children at all stages of the disease in India [24]. The other study conducted in South Africa also found, that optimal adherence improved the overall QOL and observed it was persistent along with  $>95\%$  adherence over the 12-month study period [25].

Regarding the association between the ART adherence gain score with demographic variables of HIV-infected adolescents/caregivers in the experimental group. Regarding the age and sex of adolescents, the younger age of 10-12 years and males gained a high gain score and was significant at the  $p \leq 0.05^*$ . Because the younger ages of 10-12 years were under the supervision of caregivers and especially more attention was given to males since the LFTU rates were slightly higher to gain more benefits when compared to the age group and the female adolescents. In consideration of the caregivers' age and sex, the younger of 20-35 years and females gained a high gain score and was significant at  $p=0.05^*$ . The younger ages of female caregivers played a major role in attaining the high gain scores when compared to other age categories and males. In regard to relationships with adolescents and residential areas, the high gain score was seen with mothers and adolescents residing in rural areas. It was significant at  $p \leq 0.04^*$  and  $0.05^*$  respectively. Because the primary caregivers of mothers

showed great attention towards the adolescent's health and the adolescents residing in the rural areas followed the interventions in a disciplined manner, adopting the diet modifications made it easy to gain more scores than the other types of caregivers and residing in urban areas. The rest of the other demographic variables were not associated with adherence gain score. Hence, Hypothesis H02 stated that there is no association between posttest adherence gain score with selected demographic variables of HIV-infected adolescents / Caregivers in the experimental was rejected in the experimental group and accepted for the control group.

Similar findings were supported by the following studies, [26] revealed that HIV-infected children (78.7%) needed improvement in QOL. The factors associated with poor QOL include having others as main caretakers OR 4.64, parental death OR 4.19, age of caregivers above 45 years OR 9.52, and family income  $> 5,000/-$  month OR 5.25 with 95 % CI.

However, on multivariate analysis, only the age of the caregiver was a significant predictor for the QOL of the child. The other controversial view of the study includes children who were cared for by caregivers and aged 45 years or above had a better QOL than those whose caregivers were 20-45 years old (OR 6.32, 95% CI 1.12-35.62). Therefore, to improve QOL among HIV-infected children, the age of the caregiver is an important factor to be considered [26]. The other study also found that children living with caregivers were more likely to have poor adherence compared to biological parents with OR = 2.84, 95% CI: 1.04-7.77. The children of primary school age were less significant compared to those who never went to school i.e., preschool-age children with OR = 2.39, 95% CI: 0.69-8.28 [27] Another study from [28] revealed that the absence of a primary caregiver an adolescent's clinic visit was significantly associated with virologic failure (OR 4.1 95% CI, 1.5–4.3) [28].

The RCT on HIV-infected participants, one hour of three times weekly aerobic exercises

with monthly nutritional counselling compared with a workshop on discussing the importance of physical activity and nutrition. The exercise group had significant improvements in CD4 count ( $P=0.002$ ), resting heart rate ( $P=0.001$ ), metabolic equivalents ( $P=0.014$ ), and QOL than the control group. The domains of QOL, general health, vitality, and mental health improved in the exercise group ( $P<0.05$ ) compared with the control group. The study findings suggested that the practice of regular exercises, coupled with nutritional guidance, for individuals with HIV/AIDS significantly improves the QOL [29].

## Conclusion

The successful transition of HIV-infected children through adolescence into adulthood requires a multi-disciplinary team approach including sexual and reproductive health, psycho-social support, and vocational training in order to hopefully build up for their future. This study finding suggests that adolescent-focused interventions including behavior modifications are essential to improve the CD4 count, adherence rate, nutritional status, and enhance quality of life.

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The global targets of zero infections, zero discrimination, and zero deaths in the adolescent population for HIV are within our reach but adolescents-centered interventions are needed as in tailored approach to improve the overall well-being of adolescents. This study finding revealed that motivational counselling with interventional aids of diary and yoga practice makes adolescents build a chance for a safe, happy, healthy, and productive nation in the future.

## Conflict of Interest

The author declared that there is no conflict of interest.

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