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Factors associated with non-adherence to antiretroviral treatment among HIV-infected patients in a high-altitude hospital

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Abstract

Introduction: Antiretroviral therapy (ART) has been fundamental in the management of human immunodeficiency virus (HIV) infection; however, achieving adherence to this treatment is a significant challenge, especially in unique geographic areas and populations. This study aimed to analyze the prevalence and factors associated with non-adherence to ART among patients with HIV infection in a high-altitude hospital.

Material and methods: A cross-sectional study was conducted with a total of 160 patients using questionnaire for evaluation of adherence to antiretroviral treatment in patients with HIV/AIDS (CEAT-HIV). Data processing was performed with Stata 15 program to determine the association between risk factors and non-adherence to ART, with prevalence ratio (PR) calculated by generalized linear model of family Poisson. Statistical significance was defined at a p-value of 0.05.

Results: The prevalence of poor adherence was 54.87%. Socio-demographic factors included male sex (PR: 1.45; $p = 0.039$), no family support (PR: 1.45; $p = 0.017$), and alcohol consumption (PR: 1.41; $p = 0.017$). Clinical factors were not statistically significant in the multivariate analysis.

Conclusions: Our study revealed a high proportion of non-adherence to ART. The risk factors associated with non-adherence to ART among patients with HIV/AIDS were male sex, not having family support, and consuming alcohol.

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Key words: risk factors, treatment adherence, HIV, Peru.

Introduction

The first human immunodeficiency virus (HIV) infection case reported in Peru was documented in 1983. From that time until 2021, according to the Peruvian epidemiological surveillance system, 143,732 people with HIV infection were reported, and of these, 46,641 were diagnosed as having acquired immune deficiency syndrome (AIDS). It needs to be emphasized that in the last 20 years, the number of cases with HIV and AIDS represents 84% and 71% of historical total [1-4]. The latest epidemiological data depict an estimated ratio between HIV-infected males and females as 3 : 1, which is similarly reflected in patients with AIDS.

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In the Junin region, Peru, 133 cases of people diagnosed with HIV and 41 people with AIDS were reported in 2023 [5-7]. In recent years, significant progress has been made in improving antiretroviral therapy (ART) in terms of adjusted efficacy, reduction of serious adverse effects, and/or simplification with co-formulated regimens. However, one of the causes of treatment response failure or virological failure is patients' poor adherence to ART [6]. There are several factors influencing non-adherence to treatment. Bomfim *et al.* [8] evaluated demographic and laboratory aspects associated with ART adherence, showing that 62% of patients with HIV were adhering to treatment. They also observed that living alone and having a high CD4+ count were factors associated with non-adherence, while non-smoking was a protective factor. A study by Leyva-Moral *et al.* [9] found a 58.3% of non-adherence, and the most common risk factors were tuberculosis and discomfort with ART.

It is important to mention that the province of Huancayo where the study was carried out is located in a high-Andean region. Therefore, there are different conditions, which negatively impact good adherence to treatment, such as lack of medications in some areas or difficulty in going to hospital. Hence, this study was conducted to identify the prevalence of non-adherence to treatment and possible associated factors.

Material and methods

Study design and population

This was an analytical, cross-sectional study conducted from January to August 2023.

It consisted of 160 HIV/AIDS-infected patients on ART who were treated at the Ramiro Priale Priale National Hospital in Huancayo, Peru, at an altitude of 3,250 meters above sea level.

Inclusion and exclusion criteria

Patients diagnosed with HIV/AIDS, aged over 18 years, on ART for more than 6 months, and those who signed an informed consent form and participated voluntarily were included in the study. Patients with incomplete data in clinical history or those who did not meet the inclusion criteria were excluded.

Adherence to ART

Adherence was defined as the behavior of a patient with HIV to correctly engage in the choice, initiation, and maintenance of ART, with the goal of decreasing viral replication.

Procedures

Data collection form was used to collect socio-demographic data, including sex, age, educational level, family support, marital status, economic income, occupation, sexual orientation, tobacco and alcohol consumption (10 items), and clinical factors, such as stage of the disease, treatment duration, and CD4+ cell count (3 items). To assess adherence, a survey was carried out among patients in the outpatient department of the infectious disease service during a period of 3 months, with a 10 minutes given for the questionnaire to be completed.

To measure the adherence, a questionnaire for evaluation of adherence to antiretroviral treatment (CEAT-HIV) was utilized among patients. It is a brief (20 items) multiple-choice, multi-dimensional, self-reported instrument to measure the adherence to pharmacological treatment. Based on the original tool developed by Remor *et al.* [11] for the Spanish population, the questionnaire used in our work was a version adjusted for Peruvian population, evaluating the adherence to antiretroviral treatment (CEAT-HIV) with a Cronbach's α of 0.706 [10].

Statistical analysis

A database was created using Microsoft Excel, and statistical analysis was performed with Stata 15 program. In descriptive analysis, absolute and relative frequencies were reported for qualitative variables, while for quantitative variables, normality was evaluated and, if these were variables with normal distribution, mean and standard deviation were reported. For variables with not normal distribution, median and interquartile ranges were calculated. In bivariate statistical analysis, Pearson's χ^2 test and Mann-Whitney *U* test were employed. Multiple regression analysis was performed with a Poisson family generalized linear model and log link function to assess prevalence ratio (PR) that determined the association between risk factors and poor adherence to treatment.

Ethical aspects

This study was approved by the Ethics Committee of the Hospital Nacional Ramiro Priale Priale on May 19, 2023. Informed consent was obtained before the survey was conducted, and confidentiality of the data was respected.

Results

The present study included 160 patients infected with HIV/AIDS on ART, treated in a hospital in Huancayo at 3,200 meters above sea level. It was evident that low and inadequate adherence was shown in the group with the highest proportion among the participants (81.3%), while positive adherence was observed in the lowest percentage group (18.7%). The median score of the survey was 73 points, and this value was used to categorize the adherence variable into poor adherence (≤ 73 points) and good adherence (> 73 points) in the bivariate and multivariate analyses.

Male sex predominated (59.4%), while in marital status, the highest percentage was seen in two groups: married (46.9%) and single (36.3%). Regarding educational

Table 1. Level of prevalence of ART adherence (*N* = 160)

Level	*n* (%)
Low	68 (42.5)
Inadequate	62 (38.8)
Adequate	26 (16.2)
Strict	4 (2.5)
Median of score: 73 points	
Poor adherence (≤ 73 points)	94 (58.7)
Good adherence (> 73 points)	66 (41.3)

level, technical (33.8%) and university (42.3%) groups were the most prevalent among the respondents, and more than half of the study population (56.9%) were employed. In terms of economic income, there was no marked difference between the group with ≥ 1,025 Nuevo soles (49.4%) and < 1,025 Nuevo soles (50.6%). Of the total population, 58.1% had no family support, whereas 58.1% were heterosexual. The study showed that most of the patients were tobacco users (66.3%), while alcohol consumption was declared by a low percentage (47.5%) of the study cohort. In clinical factors, most of the patients had been on treatment for > 12 months (61.9%). Similarly, in the disease stage variable, it was found that 80% of the total were at a non-AIDS stage. Finally, the median CD4+ cell count was 340 cells/mm^3 (range, 226.3-514.3).

A higher median age was found in patients with poor adherence compared with those with good adherence (age: 42.5 years vs. 37 years; $p = 0.032$) as well as male sex was associated in greater proportion to poor adherence compared with female sex (43.1% vs. 15.6%; $p = 0.000$). Additionally, it was evidenced that single marital status ($p = 0.015$), education obtained ($p = 0.000$), and employment (32.5%) were associated with non-adherence to ART, while not having family support (40.6% vs. 18.1%; $p = 0.000$) and both alcohol and tobacco consumption ($p = 0.000$) showed a significant association with non-adherence to ART.

With respect to clinical characteristics, the bivariate analysis demonstrated that treatment time (> 12 months) was statistically significantly associated ($p = 0.000$) with poor adherence (43.1%) compared with good adherence (18.8%).

In the multiple regression analysis, male sex and being single had 1.45 and 1.26 times the prevalence of non-adherence to ART. In addition, those who did not have family support had 1.45 times the prevalence of poor adherence than those with family support. Finally, consuming alcohol had 1.41 times the prevalence of non-adherence to ART.

Discussion

The prevalence of non-adherence to ART was found to be 58.7%, which is not in line with a research by Tolentino Vasques *et al.* [12] conducted in the Hospital de Chimbote, Peru, where 65% of patients showed poor adherence. Mejía

Table 2. Baseline characteristics of patients on antiretroviral treatment (*N* = 160)

Characteristics	
Age (years), mean (IQR)	41 (31.3-53.0)
Sex, *n* (%)	
Male	95 (59.4)
Female	65 (40.6)
Marital status, *n* (%)	
Married	75 (46.9)
Single	58 (36.3)
Widow(er)	7 (4.4)
Cohabitant	20 (12.5)
Level of education, *n* (%)	
Primary	6 (3.8)
Secondary	34 (21.2)
Technical	54 (33.8)
University	66 (42.3)
Occupation, *n* (%)	
Unemployed	69 (43.1)
Employed	91 (56.9)
Income (Nuevo soles), *n* (%)	
≥ 1,025	79 (49.4)
< 1,025	81 (50.6)
Family support, *n* (%)	
Yes	67 (41.9)
No	93 (58.1)
Sexual orientation, *n* (%)	
Homosexual	41 (25.6)
Transsexual	1 (0.6)
Bisexual	25 (15.7)
Heterosexual	93 (58.1)
Alcohol consumption, *n* (%)	
No	84 (52.5)
Yes	76 (47.5)
Tobacco use, *n* (%)	
No	54 (33.8)
Yes	106 (66.3)

Copala's analytical study [13] reported 72.3% of sub-optimal adherence, which is higher than that found in our study. A Brazilian investigation demonstrated good adherence to ART in 62% of cases, higher than the 41.3% found in our study [8]. Patients who did not have family support represented 58.1% of the total, which differs from Cubas Melendes' research [14], where 27% of the population did not receive family support.

Both, tobacco use declared by 66.3% of the patients and treatment time > 12 months by 61.9% correlated with sim-

Table 3. Association between risk factors and adherence to antiretroviral treatment: bivariate analysis

Factor	Good *n* = 66, 41.3%	Poor *n* = 94, 58.7%	*p*-value	Statistical test
Age (years), mean (IQR)	37 (27.8-52.3)	42.5 (34-53)	**0.032**	Mann-Whitney *U* test
Sex, *n* (%)				
Male	26 (39.40)	69 (73.40)	**0.000**	χ^2 of Pearson
Female	40 (60.60)	25 (26.60)		
Marital status, *n* (%)				
Married	37 (56.10)	38 (40.43)	**0.015**	χ^2 of Pearson
Single	15 (22.70)	43 (45.74)		
Widow(er)	5 (7.60)	2 (2.13)		
Cohabitant	9 (13.60)	11 (11.70)		
Level of education, *n* (%)				
Primary	2 (3.03)	4 (4.26)	0.916	χ^2 of Pearson
Secondary	13 (19.70)	21 (22.34)		
Technical	24 (36.36)	30 (31.91)		
University	27 (40.91)	39 (41.49)		
Occupation, *n* (%)				
Unemployed	49 (74.24)	42 (44.68)	**0.000**	χ^2 of Pearson
Employed	17 (25.76)	52 (55.32)		
Income (Nuevo soles), *n* (%)				
≥ 1,025	36 (54.55)	43 (45.74)	0.273	χ^2 of Pearson
< 1,025	30 (45.45)	51 (54.26)		
Family support, *n* (%)				
Yes	40 (60.61)	29 (30.85)	**0.000**	χ^2 of Pearson
No	26 (39.39)	65 (69.15)		
Sexual orientation, *n* (%)				
Homosexual	13 (19.70)	32 (34.04)	0.149	χ^2 of Pearson
Transexual	3 (4.55)	2 (2.13)		
Bisexual	6 (9.09)	4 (4.26)		
Heterosexual	44 (66.67)	56 (59.57)		
Alcohol consumption, *n* (%)				
No	47 (71.21)	37 (39.36)	**0.000**	χ^2 of Pearson
Yes	19 (28.79)	57 (60.64)		
Tobacco use, *n* (%)				
No	33 (50.0)	21 (22.34)	**0.000**	χ^2 of Pearson
Yes	33 (50.0)	73 (77.66)		
Treatment time, *n* (%)				
6-12 months	36 (54.50)	25 (26.60)	**0.000**	χ^2 of Pearson
> 12 months	30 (45.50)	69 (73.40)		
Stage of disease, *n* (%)				
AIDS	16 (24.24)	16 (17.02)	0.261	χ^2 of Pearson
No AIDS	50 (75.76)	78 (82.98)		
CD4+ count (cells/mm^3)	323.5 (189.7-493.7)	345 (247-535)	0.611	Mann-Whitney *U* test

ilar results obtained in Matute Salazar's study in Peru [15]. According to bivariate analysis, the highest median age was 42.5 years, and it was also associated with poor adherence to ART ($p = 0.032$). This is comparable with bivariate analyses of Soares *et al.* [16] and Dorcélus *et al.* [17] studies, which found a significant relationship ($p = 0.01$ and $p = 0.01$, respectively).

In the multivariate analysis, the variable age ≤ 41 years was not a risk factor for poor adherence. This differs from the results of a cross-sectional study by Soraes *et al.* [16], concluding that age ≤ 35 years increases the probability of poor adherence to ART (OR: 2.10; $p = 0.04$). This difference could be explained by the fact that our study considered other independent variables. Similarly, the age cut-off value in multivariate analysis differed from the study cited. In the population studied, 43.1% demonstrated poor adherence, and significant association ($p = 0.000$) with being male was found. This is not in line with national studies by Cubas Melendez [14] and Rodriguez Zapata [18], demonstrating no evidence of a significant relationship between adherence to treatment and sex ($p = 0.229$ and $p = 0.195$, respectively). This difference is due to the fact that there was a higher proportion of men than women in the studies cited, in which sex was a variable related to adherence to treatment. Conversely, the results of our research show that male sex increases the possibility of poor adherence to ART by 1.45 times, in addition to a significant association ($p = 0.009$). A study conducted in Ghana by Prah *et al.* [19] concluded that being male was a risk factor for poor adherence (OR: 2.00; $p = 0.021$).

Treatment time (> 12 months) did not indicate a significant relationship to non-adherence in the multiple regression analysis. An international study by Neupane *et al.* [20] reported that a treatment time for more than 3 years increased the possibility of poor adherence by 10 times ($p = 0.002$), as did the cross-sectional study by Wang *et al.* [21], with an OR: 10.56 and $p = 0.001$. This contrasts with a national study by Mejía Copaja [13], where the longer the treatment time, the greater the risk of not adhering to ART (OR: 3.47; $p = 0.019$). The difference in the results may be due to the different cut-off value of our variable, which in turn is supported by the work of Leyva-Moral *et al.* [9], where the population was classified into two treatment times, i.e., < 12 months and ≥ 12 months.

On the other hand, in terms of the family support variable, our results of the bivariate analysis support a statistically significant association between poor adherence and this variable. Similar results were obtained in a study conducted by Ipanaque in Piura Calderón [22], concluding that the family's non-participation is a risk factor (OR: 3.18; $p = 0.002$).

Tobacco use in the bivariate analysis was significant ($p = 0.000$), whereas in the logistic regression, our work did not show a significant association of tobacco use with non-adherence. Comparable results were obtained in Neupane *et al.* study [20], where smoking was not found to be a risk predictor for inadequate ART adherence (OR: 0.31; $p = 0.212$). A research conducted in Brazil by Soares *et al.* [16] differs from our study, such that there is a 2-fold greater probability of poor adherence with tobacco use ($p = 0.037$). This could be explained by the difference in population size, as they had approximately twice as many patients as our study.

Table 4. Association between risk factors and adherence to antiretroviral treatment: Multiple regression model

Factor	Multiple regression		
	PR	95% CI	*p*-value
Age (≤ 41 years old)		Ref.	
> 41 years old	1.08	0.85-1.36	0.537
Sex (Female)		Ref.	
Male	1.45	1.02-2.07	0.039
Civil status (Others)		Ref.	
Single	1.26	0.98-1.61	0.071
Family support (Yes)		Ref.	
No	1.45	1.07-1.96	0.017
Alcohol consumption (No)		Ref.	
Yes	1.41	1.06-1.87	0.017

PR – prevalence ratio

Finally, alcohol consumption showed a significant association with non-adherence to ART; it was demonstrated that consuming alcohol increases the risk of non-adherence to treatment by 1.41 times. A national Ipanaque Calderón [22] case-control study reported that consuming alcohol increases the risk of non-adherence (OR: 4.4; $p = 0.00$). This was supported by an international study by De Boni *et al.* [23], reporting a higher risk of non-adherence in patients consuming alcohol (OR: 2.46; $p = 0.001$).

Limitations

Other characteristics, such as treatment regimen and comorbidities were not evaluated as possible associated risk factors. Furthermore, viral load was not assessed due to lack of availability of the tests at the hospital.

Conclusions

The overall prevalence of non-adherence to ART in HIV/AIDS-infected patients was 58.7%. It was concluded that male sex, alcohol consumption, and lack of family support are the risk factors for poor adherence to ART.

Disclosures

1. Institutional review board statement: This study was approved by the Ethics Committee of the Hospital Nacional Ramiro Priale Priale on May 19, 2023.
2. Assistance with the article: None.
3. Financial support and sponsorship: None.
4. Conflicts of interest: None.

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