

BMJ Open Physical activity among HIV-positive patients receiving antiretroviral therapy in Hanoi and Nam Dinh, Vietnam: a cross-sectional study

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ABSTRACT

Objectives Antiretroviral therapy (ART) has facilitated the transition of HIV infection into a chronic disease, where adherence to medications is required along with keeping a healthy lifestyle. Therefore, an increase in physical activity has been recommended for patients with HIV in order to maintain their health status. This study looked to determine the physical activity level and its associated factors among patients with HIV receiving ART treatment.

Settings Eight outpatient clinic sites across different levels of the health systems in both rural and urban settings in Hanoi and Nam Dinh, Vietnam.

Study design and participants A cross-sectional study was performed among 1133 patients with HIV receiving ART treatment from January to August 2013.

Primary and secondary outcome measures Physical activity level was measured using the International Physical Activity Questionnaire (IPAQ). Socioeconomic, health-related quality of life, ART adherence and ART-related characteristics were self-reported.

Results 16% of participants were inactive, and 68% were reported active via health-enhancing physical activity. Rural participants reported a higher level of physical activity compared with urban participants. Participants having a longer duration of ART were less likely to be physically active. Participants who were female and self-employed, who had higher CD4 cell count, higher EuroQol - 5 dimensions - 5 levels (EQ-5D-5L) index/EQ-Visual Analogue Scale, and shared their health status with their peers were more likely to have a higher IPAQ score or be physically active. A lower IPAQ score was associated with participants living in urban areas and being at the symptomatic stage. Participants having poor adherence and longer duration of ART were more likely to be physically inactive.

Conclusion The majority of participants who received ART were physically active. There is a need for interventions to promote physical activity among patients with HIV in urban areas and in the later ART treatment phases. Other potential interventions to increase the level of physical activity include peer support and job guidance.

INTRODUCTION

The implementation of highly active antiretroviral therapy (ART) has led to significant

Strengths and limitations of this study

- This study included a large sample size of HIV-positive patients who received antiretroviral therapy treatment across different levels of the health systems in both rural and urban areas of Vietnam.
- The study employed a number of validated international instruments to ensure comparability between our results and other studies elsewhere.
- The International Physical Activity Questionnaire was a subjectively self-reported measure that may underestimate or overestimate the actual physical activity of people living with HIV.
- A convenience sampling technique was used and this may limit the generalisability of the findings as well as an accurate representation of HIV/AIDS population.
- The causal inference between the level of physical activity and the number of CD4 cells, and the level of physical activity and the quality of life, could not be established due to the study's cross-sectional design.

milestones in the reduction of HIV/AIDS-related morbidity and mortality. According to a UNAIDS report in 2016, among 36.7 million people living with HIV (PLWH), an estimated 19.5 million patients had access to life-saving antiretroviral medicines and the global coverage of ART has reached 53%.¹ PLWH who take a potent combination of antiretroviral drug regimen enjoy longer and healthier lives.¹ This improvement has also transformed HIV/AIDS into a chronic disease.² However, one of the most common adverse health effects of ART among PLWH is lipodystrophy syndrome,³ including morphological (peripheral lipoatrophy and central fat accumulation) and metabolic (hypertriglyceridaemia, hypercholesterolaemia, insulin resistance, type 2 diabetes, lactic acidaemia) symptoms.^{4 5} This contributes to an increase in risks of cardiovascular and



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other non-communicable diseases as a result of changes in adipose tissue distribution and metabolism.^{6 7} These side effects were also found to be the main reasons for patients' non-adherence to antiretroviral medication and discontinuation of therapy.^{8 9}

Since ART is a requisite for viral suppression and recovery of the immune system, it is important for health providers to identify and for patients to adopt strategies to prevent these adverse effects and achieve optimisation of treatment.^{10 11} Physical activity was recommended as an alternative and non-pharmacological treatment intervention to improve patients' health status.¹² Physical activity is defined as the movement of the body that works the skeletal muscles and expends more energy than the resting state.¹³ There are several subgroups of physical activities, such as occupational activities, conditioning exercises, sports, household tasks (eg, cradling baby, cleaning) and other activities. There are also different levels of intensity, which include light, moderate or heavy.¹³ Physical activity has been shown to be able to increase the functional capacity, muscle strength, joint flexibility, endurance and energy among PLWH.^{14 15} Engaging in physical activity has been found to reduce incidences of certain chronic diseases such as cardiovascular diseases by lowering blood pressure in patients with hypertension and improving lipid-lipoprotein profiles^{16–18}; or improving glucose homeostasis¹⁹ in people with diabetes; and breast cancer.^{20 21} Physical activity can also reverse the metabolic and body composition change of patients by lowering the visceral and subcutaneous fat in the centre of the body and increasing the diameter of the peripheral parts, therefore preventing lipodystrophy.^{22 23}

Thus, engaging in physical activities is a very important health-related behaviour for PLWH, because they are found to be less likely to do physical activity compared with uninfected patients.²⁴ A typical physical activity guideline for normal adults recommends a minimum of 150 min of moderate-intensity physical activity or 75 min of vigorous-intensity physical activity each week or an equivalent combination of moderate-intensity and vigorous-intensity activities.²⁵ The Centers for Disease Control and Prevention suggests that PLWH should comply with at least one type of physical activity in this guideline to keep healthy.²⁶ However, in many low-income/middle-income countries, the rates of physical inactivity have been shown to be more than 50% among PLWH^{27 28} in comparison with about a quarter in the USA and Australia.^{29 30} The difference depends on various factors such as gender, age groups, occupations, level of CD4 cell count and quality of life.^{27 28 30}

In Vietnam, most previous studies have focused on the physical activity levels among Vietnamese adolescents^{31 32} and adults with chronic diseases and metabolic syndromes.^{33 34} A previous study by Bui *et al*³⁵ found that 70% of the population met the WHO recommendations for physical activity level for adults aged 18–64 years old. Additionally, the socio-economic and geographical differences were considered as factors that shape attitude and behaviour towards physical activity. Prior studies also revealed that physical activity

level was greater in men compared with women³⁵ and among people who had lower educational attainment.³⁶ Furthermore, the level of physical activity in rural areas was significantly higher than those in urban settings perhaps due to more access to modern transportation systems and sedentary behaviours in the urban setting.^{35 37} A national representative survey of more than 14 700 participants in 2010 indicated that provinces with higher urban population proportions had a lesser proportion of active people.³⁸ Nonetheless, the rate of urbanisation in Vietnam has been quickly on the rise in recent years, from 21% in 2008 to 32% in 2013, and is projected to reach 45% in 2020.³⁹ These changes raise the need for understanding the potential variability of the prevalence of physical activity or inactivity between rural and urban settings, especially among people with chronic illnesses such as HIV/AIDS and other non-communicable diseases.

Currently, Vietnam is still in a concentrated HIV epidemic stage and the proportion of ART coverage is estimated approximately at 42% of the country's PLWH population in 2015.⁴⁰ Half of this number has been undergoing ART for a long time. Engaging in physical activity to reduce the risk of chronic diseases and enhance the effectiveness of the ART treatment is a potential intervention strategy to be considered by healthcare providers. However, little attention has been paid to determining the degree of physical activity as an intervention that could enhance the level of physical activity among individuals with HIV infection in Vietnam, particularly between urban and rural areas. According to the Vietnamese Constitution in 2013, an urban area is defined as a settlement with a high population density and built environment, whereas a rural area refers to a place that has a low population density and is located outside the urban setting, where people mostly work in the agriculture sector.⁴¹ Based on this definition, we hypothesised that PLWH in an urban area would have a lower level of physical activity compared with their counterparts in the rural area. This study looked to assess the level of physical activity across different settings and examine the factors associated with the level of physical activity among patients with HIV receiving ART treatment across different levels of the health systems and in both rural and urban settings.

METHODS

Study setting and subjects

A cross-sectional study was performed from January to August 2013 in Hanoi and Nam Dinh, two Vietnamese epicentres providing HIV/AIDS surveillance and treatment services in the northern region of Vietnam. The study was performed at eight outpatient clinics: five in Hanoi and three in Nam Dinh. The locations included one national hospital (Bach Mai Hospital), one provincial hospital (Nam Dinh provincial hospital), one provincial centre (Nam Dinh Provincial AIDS Control Centre) and five district health centres (Hoang Mai, Long Bien, Dong Anh, Ha Dong and Xuan Truong). The eligibility criteria for selecting outpatient clinic sites in Hanoi and

Nam Dinh included (1) being representative of the public health system in Vietnam, which has central, provincial and district levels); and (2) being able to afford ART service implemented following the official guidelines of the Vietnamese Ministry of Health.⁴²

Participants were recruited using convenience sampling technique if they met the following eligibility criteria: (1) being 18 years old or above; (2) receiving ART treatment from those clinics mentioned above; (3) having an HIV-positive confirmatory test; (4) agreeing to participate in the study; and (5) being able to communicate with the data collector. The exclusion criteria included those who suffered from serious illness during the recruitment process. We approached participants when they visited clinics for medication or to receive counselling. We identified eligible participants for the study based on the health staff's feedback. These participants were invited into a small counselling room by well-trained health workers. They were introduced to the purpose of the study, the benefits and drawbacks of participating, and were then asked to join the study. If they agreed, participants would sign a written informed consent. We ensured the participants of the confidentiality of their participation in the study. The consenting process took place in a comfortable room with restricted access, which allowed participants to have some privacy as they decide whether or not to join the project.

Measures and instruments

Participants were invited to participate in 20 min face-to-face interviews. Data were ascertained through interview-administered questionnaires conducted by data collectors who were medical students at Hanoi Medical University and experts in HIV-related fields. We did not involve health staff in collecting data to avoid social desirability bias. We developed a structured questionnaire with the following information:

Socioeconomic characteristics

We asked participants to report their socioeconomic information, which included gender (male/female), education attainment (illiterate/elementary/secondary/high school/vocational training/university), age, marital status (single/live with spouse/live with partner/divorced/widow), religion (cult of ancestors/Buddhism/Catholic/Protestant) and employment status (unemployed/self-employed/white-collar/blue-collar or farmer/others).

ART-related characteristics

We asked each participant for a self-report of their latest CD4 cell count, HIV stages (any asymptomatic/symptomatic condition defined as 'HIV-infected patients having clinical symptoms but not including AIDS-Indicator Conditions that meet at least one of the eligible criteria/AIDS Indicator Conditions')⁴³ and ART treatment duration. Data on viral load were not collected due to their unavailability at the time of the study.

Non-adherence to ART was measured by self-report items. First, ART adherence of the last month was determined by a Visual Analogue Scale (VAS) where 0 point showed complete non-adherence and 100 points showed complete adherence.⁴⁴ Participants were asked whether they forget to take ART medicine in the last 4 days. This approach has been applied successfully in a previous study.⁴⁵ We also asked the participants about whether they received peer support during ART treatment (yes/no) and whether they shared their health status with their peers (yes/no).

Health-related quality of life

Health-related quality of life was measured using the EuroQol-5 dimensions - 5 levels (EQ-5D-5L) instrument in the Vietnamese version, which was validated elsewhere.⁴⁶ This tool measures five dimensions of health-related quality of life including mobility, self-care, usual activities, pain/discomfort and anxiety/depression with five response levels: no problems, slight problems, moderate problems, severe problems and extreme problems. The combination of responses gives 3125 position health statuses with an aggregate single index weighting.⁴⁶ The Cronbach's alpha of this instrument was 0.85 with a good convergent validity.⁴⁶ Furthermore, we also used the EQ-VAS, which measures the self-rated health on a 20 cm vertical scale, with the endpoint ranging from 0 to 100 points, labelled 'the worst health you can imagine' and 'the best health you can imagine'.⁴⁷

Physical activity

To assess the level of physical activity of the participants, we used the International Physical Activity Questionnaire (IPAQ). The IPAQ was developed for use in adults aged 15–69 years old.⁴⁸ Several questions were used to assess three specific types of activity: vigorous activity, moderate activity and walking activity. Examples for each type of activity in our research context are listed below:

- ▶ Vigorous activity: heavy lifting, hoeing, weight lifting, fast-paced cycling and others.
- ▶ Moderate activity: playing badminton, slow-paced cycling, cradling baby, selling and others.
- ▶ Walking activity: going to work, going to school, going elsewhere, going jogging and others.

Each activity was scored separately by frequency (measured by days per week) and by duration (measured by times per day). The volume of each activity was also measured by its energy requirement determined in METs (Metabolic Equivalent of Task and METs are a multiple of the resting metabolic rate).⁴⁸

The total IPAQ score was used as a continuous variable, which was calculated by adding the MET minute per week of the three types of activity. We also evaluated the IPAQ score as a categorical variable, which divided the physical activity into three levels: inactive, minimally active and health-enhancing physical activity (HEPA) active.

Participants were categorised into (1) HEPA-active group if they did the following:

- ▶ Vigorous activity for at least 3 days and obtained a total physical activity of at least 1500 MET-min/week.
- ▶ Or 7 or more days of combination physical activities of walking, moderate-intensity or vigorous activities and obtained a total physical activity of at least 3000 MET-min/week.

Participants were in the (2) minimally active group if they had the following:

- ▶ 3 or more days of vigorous activity of at least 20 min per day (800 MET-min/week).
- ▶ Or 5 or more days of moderate activity or walking of at least 30 min per day.
- ▶ Or 5 or more days of walking combining with moderate-intensity or vigorous-intensity activities and obtained at least 600 MET-min/week.

Participants were (3) inactive or were determined as insufficiently active⁴⁸ if they did not meet the requirements for category 2 or 3.

Statistical analysis

Data were analysed by STATA V.12. A χ^2 test and a Mann-Whitney test were used to analyse the demographic characteristics of the participants, as well as the health-related quality of life, ART status and sexual behaviours. Multivariate linear regression was employed to identify factors associated with IPAQ score. Because the IPAQ score had a non-normal distribution, we performed log transformation for this variable in order to meet the requirement of the regression model. We also applied multivariate logistic regression to identify factors associated with whether the participants were active in physical activity or not. We applied a forward stepwise selection strategy to remove non-significant factors; the p value of log-likelihood ratio test was set as less than 0.1, and this was the threshold to include a variable. A p value <0.05 was considered statistically significant.

Patient and public involvement

We conducted a pilot survey of 50 participants of different ages, genders and occupations, and only minor changes to the wording were made in order to meet patients' preferences and culture. After revision, we performed data collection using a structured questionnaire. Participants did not take part in the recruitment as well as in the conduct of the study. We aim to present our study results at national and international scientific meetings, as well as publish our study in open-access journals. Therefore, our study is widely available to be disseminated to study participants and other interested international researchers.

RESULTS

A total of 1200 patients were invited to participate in the study and 1133 patients agreed to enrol. The reasons for refusal included insufficient health, discomfort or having busy work schedules.

The demographic and socioeconomic characteristics of participants living in rural and urban are given in [table 1](#).

Out of 1133 ART patients, approximately 60% was male. The majority had secondary and high school education (36.9% and 32%, respectively); participants in urban areas had higher education than people in rural area ($p=0.04$). Marital status and employment were also significantly different between the rural and urban groups ($p<0.01$). There was no difference in age group between rural and urban participants.

ART status

About half of the participants were asymptomatic, and the percentage of the rural participants who were unaware of their stage of HIV infection was significantly higher than the urban participants (52.1% vs 24.7%) ([table 2](#)). The mean number of CD4 measurements and duration of ART treatment were $294.7 \text{ cells} \times 10^9/\text{L}$ ($SD=215.2$) and 3.5 years ($SD=2.2$), respectively. About 50% of the participants shared health status with their peers and only one-third received peer support.

Self-reported health status

The percentage of urban participants who reported having any problem in mobility, self-care and doing usual activities was significantly higher than those of rural participants ($p<0.01$) ([table 3](#)). About 40% of the participants reported suffering from anxiety or depression, and about half of the participants reported suffering from pain or discomfort, with no significant difference between rural and urban participants. The mean EQ-5D-5L index was 0.8 ($SD=0.2$) and the perceived EQ-VAS score among rural participants was statistically significantly higher than those of urban participants ($p<0.01$).

Physical activity level

[Table 4](#) shows that 16% of the participants were inactive and 68% were HEPA-active using the IPAQ. Rural participants reported a statistically higher level of physical activity and IPAQ score compared with urban participants ($p=0.03$ and $p<0.01$, respectively). In terms of moderate activity, the number of days per week and the mean value of MET scores from participants living in rural areas were higher than those in urban areas ($p<0.01$ and $p=0.01$, respectively). However, the mean MET scores of vigorous activity and walking activity were similar between the two groups.

The IPAQ score was also found to be differentially associated with ART treatment duration ([figure 1](#)). A higher IPAQ score was associated with a shorter ART duration, and longer ART treatment was associated with a lower IPAQ score. Specifically, the score increased within the first year of ART, plateaued during 2–4 years of treatment, and then decreased.

Factors associated with level of activity

[Table 5](#) illustrates that participants were more likely to have a higher IPAQ score and classified as physically active if they were female, self-employed, and blue-collar workers or farmers. Participants who had a higher CD4 cell count, who shared their health status with their peers

Table 1 Socioeconomic characteristic of PLWH in the study (n=1133)

	Rural		Urban		Total		P values
	n	%	n	%	n	%	
Gender							
Male	145	56.2	520	59.4	665	58.7	0.36*
Female	113	43.8	355	40.6	468	41.3	
Education							
Illiterate	5	1.9	7	0.8	12	1.1	0.04*
Elementary school	48	18.6	172	19.7	220	19.4	
Secondary school	109	42.3	309	35.3	418	36.9	
High school	80	31	282	32.2	362	32	
Vocational training	6	2.3	48	5.5	54	4.8	
University	10	3.9	57	6.5	67	5.9	
Marital status							
Single	26	10.1	143	16.3	169	14.9	0.01*
Live with spouse	178	69	507	57.9	685	60.5	
Live with partner	0	0	8	0.9	8	0.7	
Divorced	22	8.5	66	7.5	88	7.8	
Widow	32	12.4	151	17.3	183	16.2	
Religion							
Cult of ancestors	222	86.1	779	89	1001	88.4	0.03*
Buddhism	12	4.7	43	4.9	55	4.9	
Catholic	24	9.3	44	5	68	6	
Protestant	0	0	9	1	9	0.8	
Employment							
Unemployed	47	18.2	184	21	231	20.4	<0.01*
Self-employed	98	38	371	42.4	469	41.4	
White-collar worker	13	5	67	7.7	80	7.1	
Blue-collar worker or farmer	94	36.4	188	21.5	282	24.9	
Others	6	2.3	65	7.4	71	6.3	
	Mean	SD	Mean	SD	Mean	SD	
Age	35.6	6.6	35.5	7.0	35.5	6.9	0.6†

Significance level was $p < 0.05$.

* χ^2 test.

†Mann-Whitney test.

PLWH, people living with HIV.

and who reported a higher EQ-5D-5L index/EQ-VAS were also more likely to have higher IPAQ score or be physically active. By contrast, a participant with a lower IPAQ score was associated with living in an urban area and being at the symptomatic stage. In addition, participants who had poor adherence and longer duration of ART were more likely to be physically inactive.

DISCUSSION

Findings of this study suggest that PLWH in urban areas reported a lower level of physical activity compared with their peer in rural settings. In our study, a majority of ART patients achieved HEPA-active status in physical activity. By

using multivariate regression models, we found a number of sociodemographic, clinical and social factors that are associated with the level of physical activity among PLWH in Vietnam. These results could contribute significantly to the development of interventions aimed to boost the level of physical activity among this population in the future.

Compared with previous studies on ART patients using the IPAQ system, the percentage of inactive (16%) or minimally active (16%) participants in our study was much lower.^{12 27 29 30} Most participants reported the highest frequency of moderate activity (playing sport, cycling, cradling baby and others), which was different from previous studies' findings that walking was the most preferred physical activity among PLWH.^{14 30}

Table 2 Antiretroviral therapy status of participants (n=1133)

	Rural		Urban		Total		P values
	n	%	n	%	n	%	
HIV period							
Asymptomatic	67	28.4	389	46	456	42.1	<0.01*
Symptomatic	32	13.6	161	19	193	17.8	
AIDS	14	5.9	87	10.3	101	9.3	
Unknown	123	52.1	209	24.7	332	30.7	
ART duration (year)							
1 year	47	19.0	213	26.9	260	25.0	<0.01*
2–4 years	91	36.9	354	44.7	445	42.8	
More than 4 years	109	44.1	225	28.4	334	32.2	
Share health status with peers							
Yes	110	43.3	446	52.7	556	50.6	0.01*
No	144	56.7	400	47.3	544	49.5	
Receiving peer support							
Yes	77	29.8	314	35.9	391	34.5	0.07*
No	181	70.2	561	64.1	742	65.5	
Forgetting to take medicine in the last 4 days							
No	243	98	780	97.7	1023	97.8	0.82*
Yes	5	2	18	2.3	23	2.2	
	Mean	SD	Mean	SD	Mean	SD	
ART duration (year)	4.0	2.4	3.3	2.1	3.5	2.2	<0.01†
CD4 cell count ($\times 10^9/L$)	312.5	220.6	289.2	213.4	294.7	215.2	0.08†
ART adherence (VAS)	94.8	8.2	93.9	11	94.1	10.4	0.55†

Significance level was $p < 0.05$.

* χ^2 test.

†Mann-Whitney test.

ART, antiretroviral therapy; VAS, Visual Analogue Scale.

These activities can have a positive effect on PLWH by decreasing the side effects associated with HIV/AIDS and cardiometabolic complications accompanied with

ART treatment.^{15–49} However, a number of participants in our study reported having difficulty in mobility, which limited their ability to engage in healthy physical

Table 3 Health status among participants (n=1133)

	Rural		Urban		Total		P values
	n	%	n	%	n	%	
Self-reported health problems							
Mobility	33	12.8	199	22.7	232	20.5	<0.01*
Self-care	12	4.7	98	11.2	110	9.7	<0.01*
Usual activities	26	10.1	162	18.5	188	16.6	<0.01*
Pain or discomfort	85	33.0	342	39.1	427	37.7	0.07*
Anxiety or depression	104	40.3	405	46.3	509	44.9	0.09*
Complications and concurrent disease	76	29.5	329	37.6	405	35.8	0.02*
	Mean	SD	Mean	SD	Mean	SD	
EQ-5D-5L index	0.8	0.2	0.8	0.3	0.8	0.2	0.18†
EQ-VAS	70.1	16.0	68.4	17.6	68.8	17.3	<0.01†

Significance level was $p < 0.05$.

* χ^2 test.

†Mann-Whitney test.

VAS, Visual Analogue Scale; EQ-5D-5L, EuroQol - 5 dimensions - 5 levels.

Table 4 Physical activity levels of participants

	Rural		Urban		Total		P values
	n	%	n	%	n	%	
Level of physical activity							
Inactive	29	11.3	152	17.4	181	16.0	0.03*
Minimally active	37	14.3	144	16.4	181	16.0	
HEPA-active	192	74.4	579	66.2	771	68.0	
	Mean	SD	Mean	SD	Mean	SD	
Vigorous activity							
Days per week	1.5	0.2	1.2	0.1	1.3	2.5	0.09†
Minutes per day	95.4	11.2	81.1	6	84.4	177.6	0.15†
MET score	4360.9	555.5	3444.4	282.5	3651.9	8465.9	0.11†
Moderate activity							
Days per week	5.4	0.2	4.8	0.1	4.9	2.8	<0.01†
Minutes per day	170.2	5.7	155.9	3.3	159.1	96	0.04†
MET score	4211.3	165.7	3737.9	92.2	3845.9	2711.1	0.01†
Walking activity							
Days per week	3.4	0.2	3.3	0.1	3.4	3.3	0.67†
Minutes per day	18.6	1.8	21.8	1.3	21.1	36.8	0.99†
MET score	377.1	38.3	451.5	29.3	434.6	816.3	0.87†
IPAQ score	8977.9	535.5	7613.5	280.5	7922.9	8333.8	<0.01†

Number of total participants, n=1133.

Significance level was p<0.05.

* χ^2 test.

†Mann-Whitney test.

HEPA, health-enhancing physical activity; IPAQ, International Physical Activity Questionnaire; MET, Metabolic Equivalent of Task.

activities regardless of living location. With this information, health staff could provide alternative methods of exercising such as passive motion exercise, hydrotherapy or stationary cycling, which are found to be just as effective for enhancing functional fitness as active exercise practice.⁵⁰

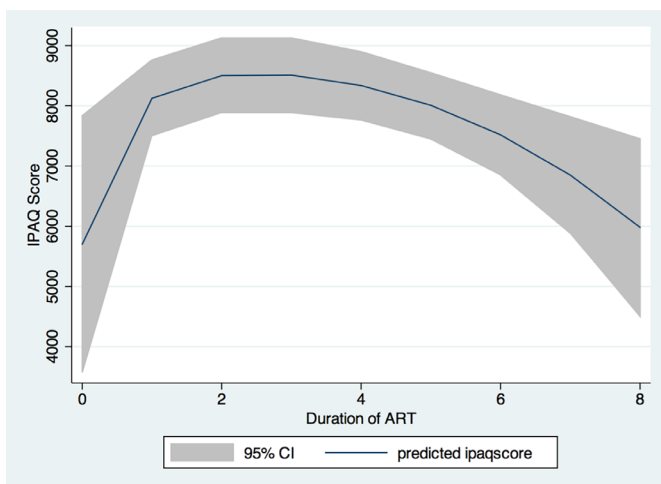


Figure 1 Physical activity among antiretroviral therapy (ART) patients in terms of ART duration. IPAQ, International Physical Activity Questionnaire.

The total physical activity score in rural areas was higher than the score in urban areas in our study, which is consistent with the physical activity level of the general Vietnamese population.³⁵ There are certain environmental factors in rural areas such as the condition of sidewalks, the availability of exercise equipment and the sedentary behaviour in urbanised setting, which may affect individuals' willingness to participate in physical activity.^{37 51} At the same time, in Vietnam, the main occupations in rural areas are farming and blue-collar works, in which the rural participants often consider working on the farm or in heavy working conditions as vigorous and moderate physical activities. However, the MET score obtained by walking activity indicated that this was the least performed physical activity and this did not differ between rural and urban areas. This can be due to factors such as low residential density and long distances between destinations in rural areas that may discourage people from walking.⁵² Similarly, in urban settings, walking intensity could be influenced by the presence or lack of pedestrian infrastructure such as sidewalks, as well as safety concerns from crime or traffic flow.⁵³

Our study also found that participants who were unemployed were less likely to be physically active, which concurs with prior findings.^{54 55} Unemployed patients are

Table 5 Factors associated with levels of physical activity among antiretroviral therapy patients in Vietnam in 2013

	IPAQ score		Active	
	Coefficient	95% CI	OR	95% CI
Gender (female vs male)	0.25*	0.11 to 0.39	2.53*	1.58 to 4.07
Living location (urban vs rural)	-0.17*	-0.34 to -0.01	0.60	0.3 to 1.05
Education attainment (vs illiterate)				
High school			1.52	0.94 to 2.46
Religion (vs cults of ancestor)				
Buddhism			2.78	0.73 to 10.57
Occupation (vs unemployed)				
Self-employed	0.60*	0.41 to 0.79	2.98*	1.78 to 4.99
White-collar workers	0.29	-0.02 to 0.59	2.43	0.87 to 6.79
Blue-collar worker/farmers	0.73*	0.52 to 0.94	2.24*	1.27 to 3.95
Others	0.53*	0.22 to 0.84	3.28*	1.07 to 10.05
EQ-5D index			4.49*	1.68 to 12.02
EQ-VAS	0.01*	0.00 to 0.01	1.02*	1.00 to 1.03
Current CD4 cell count	0.01*	0.00 to 0.01	1.02*	1.01 to 1.03
ART duration			0.91*	0.82 to 0.98
HIV stages (vs asymptomatic)				
Symptomatic	-0.20*	-0.38 to -0.01		
AIDS			1.81	0.87 to 3.79
Forgetting to take medicine in the last 4 days (yes vs no)			0.26*	0.09 to 0.80
Share health status with peers (yes vs no)	0.26*	0.12 to 0.40	1.86*	1.21 to 2.84

*P<0.05.

ART, antiretroviral therapy; IPAQ, International Physical Activity Questionnaire; VAS, Visual Analogue Scale; EQ-5D-5L, EuroQol - 5 dimensions - 5levels.

less likely to obtain adequate physical activity because an occupational activity is likely to be included as a component of daily physical activity in adulthood.⁵⁶⁻⁵⁸ In addition, our study found that female participants were more likely to get a higher level of physical activity. This can be explained by the fact that in the traditional Vietnamese culture, women still have many responsibilities requiring physical movements such as taking care of their children and all household activities, which were mainly classified as moderate physical activity in our study.^{59 60}

Interestingly, we found that people who reported a longer duration of ART were less likely to be physically active. Notably, this association was found in a non-linear relationship. This is likely because these patients may have had to adapt to a rigorous adherence at the initiation of their treatment, which might have promoted their willingness to involve in physical activities.^{45 61 62} However, they might become more complacent when their health status recovered in the latter stages and less motivated to comply to any strict physical regimen.^{45 61} Findings from another study emphasised the role of age in the relationships between the advanced stages of HIV disease and worse physical function.²⁴ As prolonged ART treatment has been positively associated with an accelerated ageing process, age-related comorbidity may reduce patients'

level of physical activity intensity.²⁴ However, in this study, the influence of age on the level of physical activity was not statistically significant since it was dropped out of multivariate regression model. We also observed that non-adherence to ART was associated with a physically inactive status. Other studies also revealed that a low level of physical activity has been found to be significantly related to a low antiretroviral medication adherence.^{61 63} This finding can be explained by the fact that engaging in physical activity can reduce depressive symptomatology, which may lead to a more optimal ART adherence.⁶³

In this study, we combined both EQ-5D-5L and EQ-VAS instruments due to the variation of health utility scores based on different instruments.⁶⁴ EQ-VAS is a self-reported instrument that directly assesses the perceived health status of patients in the short term. Meanwhile, the EQ-5D index is composited by five domains that indirectly measure the quality of life in the long term.⁶⁵ In the short term, patients' hope for improving their health condition might influence their perceived health status. On the other hand, in the long term, because of the acclimation with their health status, patients tend to report quality of life more accurately.⁶⁴ In terms of health status, participants who reported a higher quality of life and a higher number of CD4 cell count also had a higher IPAQ

score, while participants at the symptomatic stage had a lower IPAQ score compared with those at the asymptomatic stage. We supposed that engaging in physical activity would help patients improve and maintain their strength and quality of life. Two systematic reviews by O'Brien *et al*^{66 67} in 2016 and 2017 found that exercises including aerobic and resistive or a combination of both performed at least three times per week for at least 5 weeks may lead to improvements in cardiopulmonary fitness, strength, weight and body composition, and quality of life among PLWH who are medically stable.

Our current study suggested that participants who shared their health status with their peers were more likely to have higher IPAQ scores. The association between peer support and physical activity was investigated by Jerome *et al*,⁶⁸ who found that peer support was an important determinant to assist patients in adhering to exercise programmes. Additionally, WHO, President's Emergency Plan for AIDS Relief and Global Fund have proposed that social support should be considered as an effective adjunct in improving physical health among PLWH receiving ART treatment.^{69 70} As PLWH were more vulnerable and withdrawn from social situations,⁷¹ peer support can have a positive effect on patients' health through sharing relevant personal experiences to acquire knowledge, reduce stigma and discrimination, improve physical functioning, and enhance retention in ART treatment.⁷²⁻⁷⁴

Several implications can be drawn from this study. First, providing different physical activity strategies based on rural and urban settings is necessary to improve the health status of PLWH in these areas. For example, health staff in urban clinics may organise some outdoor activities via peer educators/groups to engage urban patients in physical activity. Second, job opportunities and vocational training should be prioritised to promote physical activity among ART patients.^{54 55} Third, the reduction in IPAQ score observed in prolonged ART duration suggests that physical health assessments and appropriate physical activity programmes such as resistance training and aerobic exercises should be in place. Additionally, passive motion exercises should be considered for immobilised patients or those who had difficulty in mobility or physical impairments.⁵⁰ Fourth, given the association between the level of physical activity and ART treatment status from our findings, integrative intervention including physical activity, ART medication adherence and health-related quality of life may prove to be efficient and cost-effective.⁶³ Finally, programmes promoting social support, especially among peers, should be prioritised to enable patients with HIV to share their experiences that motivate others to be involved in physical activity.⁶⁸ Furthermore, peer support groups integration into assigned health facilities would be useful to patients who are at the initial ART medication stage.

The strengths of this study included the large sample size of HIV-infected patients receiving ART treatment, which increased the statistical power of the result.

Additionally, we recruited participants from different levels of the health systems (central, provincial and district ART clinics) in both rural and urban areas, which made the sample more representative of the general Vietnamese population. We also employed international instruments such as IPAQ and EQ-5D-5L, which would help increase comparability between our results and other global studies.

However, several limitations should be acknowledged. First, a convenience sampling technique was used, which may limit the generalisability of our findings to other settings and patient populations. Second, because the collected data were based on self-reported information, it is susceptible to be influenced by interviewers, social desirability and recall bias. To minimise these biases, interviewers affiliated with selected health centres were excluded from the study and patients were given clear instructions on the benefits and drawbacks of the study. Third, the causal inferences could not be established due to the cross-sectional design. Finally, some barriers to physical activity such as social factors (stigma, discrimination), family support or clinical settings (healthcare providers) were not fully addressed in this study, warranting further research to elucidate these gaps.

CONCLUSION

In conclusion, findings from this study provided many suggestions for potential health behaviour interventions to improve the level of physical activity for patients with HIV receiving ART in rural and urban Vietnam. Healthcare providers should consider developing peer support and job guidance programmes for PLWH as they have great potentials to increase PLWH's level of physical activity, quality of life and overall health status. Furthermore, future studies of a similar population in different settings (coastal, mountainside and others) are needed to confirm the positive association between the high level of physical activity and ART adherence.

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Data sharing statement The data that support the findings of this study are available from the Vietnam Authority of HIV/AIDS Control, but restrictions apply to the availability of these data, which were used under licence for the current study and so are not publicly available. Data are however available from the authors upon reasonable request and with permission from the Vietnam Authority of HIV/AIDS Control.

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