

The Relationship between Depression, Doing Exercise, Age and Cigarettes Smoking in ARV - HIV Patients

Vu Hoang Anh Nguyen¹, Uyen Thi Bich Nguyen², Thanh Nguyen Ai Tran³, Yen Thi Hoai Phan⁴, Ngoc-Anh Truong⁵, Huyen-Trang Luu-Thi^{6*}, Vinh-Long Tran-Chi⁷

¹Department of Psychosomatic Medicine, Thu Duc Hospital, Ho Chi Minh City, Vietnam, hoanganhv.vu@gmail.com

²Department of Internal Medicine – Thu Duc city Hospital, Ho Chi Minh City, Vietnam, uyendt0610@gmail.com

³Department of Internal Medicine – Thu Duc city Hospital, Ho Chi Minh City, Vietnam, aithanh.tranguyenbvtd@gmail.com

⁴Faculty of Public Health - University of Medicine and Pharmacy at The Ho Chi Minh City, Vietnam, phanhoaiyen@gmail.com

⁵Faculty of Psychology, Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam, anhtruong3779@gmail.com

⁶Department of Psychology, Asia University, Taiwan, luuthihuyentrang.psy@gmail.com

⁷Faculty of Psychology, Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam, longtcv@hcmue.edu.vn

*Corresponding Author: E-mail: luuthihuyentrang.psy@gmail.com

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ABSTRACT

Introduction: HIV/AIDS has negative effects on the patient's mental health and social interaction, in addition to its negative effects on their physical health. Depression disorder is considered the second mental disorder in the world among patients with HIV/AIDS affects their life and causes social stigma. In Vietnam, various studies on HIV patients and depression disorders were examined. However, there are also many limitations in research with many aspects relate to the mental health quality in HIV patients. This cross-sectional study was conducted to examine the relationship between depression, smoking cigarettes, exercise habits and age in ARV - HIV patients.

Methods: A qualitative approach was utilised to conduct the randomised investigation. The PHQ - 9 scale was used for evaluating depression in 128 Vietnamese ARV - HIV patients participating in the study.

Results: According to the findings, depression and exercise have been shown to have a positive effect on smoking among HIV patients, and geriatric HIV patients are significantly less likely to smoke.

Conclusion: HIV-positive individuals require an accurate identification and assessment of depressive symptoms, with the potential implementation of personalized exercise intensity programs aimed at assisting HIV patients in ceasing tobacco use. In addition, the study recommended exercise planning and patient adherence surveillance as means for assessing and modifying the treatment of HIV patients.

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INTRODUCTION

Despite significant advancements in understanding HIV, including its transmission, physiology, effective treatments, and interventions that have markedly improved outcomes for individuals with HIV, the disease remains a global challenge. Although the worldwide prevalence of HIV is on the decline, the total number of individuals living with HIV remains considerable. HIV/AIDS leads to a series of complications that impair the human immune system, causing socio-cultural issues and impacting the healthcare system. Research indicates significant variations in the prevalence of depression among HIV/AIDS patients across different regions: 28% in France (1), 40.6% in Brazil (2), and 50.8% in China (3). This mental health burden significantly affects patients' social interactions and overall well-being, in addition to the physical health detriments. Furthermore, individuals with HIV/AIDS often encounter stigma and discrimination, and access to mental health services for this population is inadequate. Studies have consistently shown that the majority of people living with HIV experience higher rates of depression and anxiety compared to

the general population (4). Depression, in particular, is noted as the world's second most common mental disorder among HIV/AIDS patients, exacerbating social stigma and adversely affecting their lives (5).

Individuals who have contracted HIV are confronted with emotional reactions upon receiving a diagnosis (6) while enduring physical distress and disease (7). Depression is a prevalent mental condition that impacts individuals across all age groups and demographics. Among them, those diagnosed with HIV/AIDS have the highest prevalence of depression and experience the lowest quality of life (8). Research has demonstrated that the prevalence of depression in those who are HIV-positive is fourfold greater (7). Depression decreases the ability to be productive, leads to social isolation, and causes physical deterioration in those with HIV/AIDS. This aspect is among several that lead to unemployment and concurrently poses challenges for patients in resolving their issues, hence augmenting their propensity for engaging in criminal activities (9). A depressive condition is identified when the symptoms of boredom worsen and persist, negatively impacting an individual's quality of life and capacity to adjust (10). Psychiatrists previously regarded depression as a conventional sad episode. Depression is characterized by a significant impairment in mental health functioning, which manifests through traditional symptoms such as a diminished mood, cognitive slowdown, and psycho-motor inhibition that may progress to a state of stupor and immobility (11). Depression problems have been found to exacerbate the course of the disease by several mechanisms, including the exacerbation of pain, impaired adherence to therapy, disruption of the immune system, and reduction in social support. The timely identification and intervention of depression are of utmost importance due to its association with suboptimal self-care and health outcomes (12), as well as lower quality of life in those living with HIV.

Depression and HIV

Depression was a recognized predicted factor of negative clinical results (3), decreased treatment adherence, increased risk of medical illness, as well as exacerbated disease progression and increased mortality. Additionally, depression disorders may prolong the medical treatment process for HIV/AIDS [14] and is a risk for HIV infection, facilitating virus transmission (15). Several factors influence the development of depression disorders in HIV - infected patients, including neurobiological changes due to the emergence of the virus, response to social stigma, sexual dysfunction, dealing with illness and death, and reaction with antiperspirant therapy and comorbidity (16). The diagnosis of major depressive disorders for HIV patients is a challenge and complicated for clinicians due to biological, psychological, and social elements. There are some duplicates between depressive symptoms and the physical symptoms of HIV disease (17) because the clinical symptoms of depression (such as fatigue, anorexia, sleep disturbances, and weight loss,...) also exist in HIV - infected.

Indeed, persons who are living with HIV are a susceptible population that requires physical, social, and spiritual assistance, along with specialized medical attention. Enhancing the ability of HIV/AIDS patients with mental health to manage their illnesses will lead to an enhancement in their quality of life and adherence to treatment. This, in turn, will foster their drive to persist in their lives, employment, and societal contributions. In addition, Nakimuli Mpungu and Musisi (2018) have put forth intervention programs to address mental illnesses among this demographic. These programs encompass chemotherapy and psycho-therapeutic therapies, which are intended to improve both physical and psychological well-being. The intricate nature of the association between depressive illness and HIV is noteworthy. Depression might potentially enhance the probability of HIV transmission or promote more cross-infection (15). Additionally, it may occur as a result of HIV infection in persons who are already infected (19). Various research has indicated a substantial incidence of major depressive disorder among individuals infected with HIV/AIDS. However, it is essential to note that the prevalence of these studies is notably high. Several potential factors could contribute to the onset of depressive disorder in individuals infected with HIV. These factors encompass neurological changes associated with the presence of the virus in the central nervous system, the individual's response to anticipated social and sexual dysfunction, their capacity to manage illness and fear of mortality, as well as the adverse effects of antiretroviral therapy (ARV) and the presence of comorbidities (20). Numerous more research has underscored the occurrence of depression among individuals living with HIV, spanning from the first phase of diagnosis to the specific diagnosis and even the stage of near-death (21). Depression is a significant indicator of unfavorable treatment results in individuals with HIV/AIDS (13), leading to

reduced compliance with medication, diminished quality of life, and impaired physiological processes (22) while also elevating the likelihood of internal illnesses. However, recent studies have shown evidence that accurately diagnosing and treating depressive illness can enhance medication adherence, psycho-social functioning, and quality of life among HIV-positive individuals (23). The evidence suggests regular clinical observation and assessment are crucial for timely therapy.

Depression and Age among HIV patients

The research of Betancur, Lins examined HIV patients aged eighteen to sixty-five. The findings indicated that 59.5% of the participants exhibited moderate to severe depressive symptoms, while 44.7% experienced moderate to severe anxiety symptoms. Additionally, 46.8% of the patients reported experiencing depression as a result of non-antiretroviral therapy (24). In a similar vein, Abadiga observed that 41.7% of individuals diagnosed with HIV/AIDS experienced a depressive illness. Factors such as perceived social stigma, opportunistic infections, unpleasant medication responses, lack of social support (from family, friends, and others), and other chronic conditions are found to have a significant association with depression (25). Healthcare professionals should promptly identify and address adverse drug responses and chronic illnesses while also promoting the dissemination of HIV-related health information within the community to mitigate societal stigma. According to Camara, Sow, reported that the occurrence of depression and general anxiety among HIV patients was 8.1%, with depression rates of 16.9% and anxiety rates of 13.3%. Individuals who have a Body Mass Index (BMI) below eighteen and are not receiving antiretroviral treatment demonstrated heightened levels of depressive symptoms (26).

Smoking cigarettes, depression and doing exercise

Smoking cigarettes affects an individual's lifestyle, behavior, risk of health, and medication adherence. However, smoking is regular in HIV-infected patients (27), and more than 70% of patients with HIV still smoke even though compromised immune systems (28). According to Humfleet, Delucchi indicated that people with HIV were significantly more likely to smoke cigarettes than the general population (29). In the United States, 42 to 47% of HIV - infected individuals smoke cigarettes (30). The purpose of HIV treatment is to help the patient live longer and better health; smoking is considered a health - damaging factor that causes illness and premature death (31). Depression disorders may have other detrimental outcomes, including fatigue and smoking (32). Based on clinical recommendations, it has been demonstrated that drunkenness, smoking, and melancholy are notable risk factors associated with morbidity and death among individuals both infected with HIV and those who are not infected with HIV. Prior research has presented information about the impact of smoking on individuals infected with HIV, specifically about the presence of comorbid depression that is linked to current smoking (33). Smoking and alcohol usage were shown to be associated with mental health issues, particularly depression (34). According to research by Lee, Maria showed that depressive symptoms were predicted by smoking and alcohol consumption frequency (35). Smoking correlates with poor treatment adherence and increased depression symptoms; as well as depression also mediates treatment non - adherence in smokers (36). Smokers have more depressive symptoms than non - smokers in patients with HIV. Leventhal and Zvolensky reported emotional vulnerabilities that could explain the relationship between depression and smoking, including anhedonia, anxiety sensitivity, and poor tolerance (37). Agterberg, Weinberger highlighted the importance of employing smoking cessation techniques as a means to enhance depressed symptoms (38). In addition, there has been research conducted on the possible efficacy of physical activity or exercise as a therapeutic intervention for drug addiction and smoking cessation (39). Exercise effectively prevents and reduces chronic comorbidities' severity by reducing visceral obesity, inflammatory responses, and oxidative stress, increasing endothelial function (40), and improving mental health. An assessment has demonstrated that implementing a physical intervention that involves arranging weekly exercise sessions using mobile phones, message boards, and email reminders is a completely automated system capable of enhancing and sustaining physical activity in adults (41). The finding has prompted research examining the effect of exercise on the progression of HIV disease. For exercisers to attain these benefits, these individuals must regularly exercise at home (42). McDonald, O'Brien to achieve notable enhancements in cardiopulmonary health and psychological well-being among HIV patients, it is necessary to engage in aerobic exercise or a combination of aerobic exercise and

resistance exercise three times per week for a minimum of five weeks, with each session lasting at least twenty minutes McDonald, O'Brien (42).

The present study

In Vietnam, various studies on HIV patients and depression disorders were examined. Thai, Jones found that 36.5% of HIV patients had clinical symptoms of depression (43). This study examined the factors that predicted depression, which included self - reported poor health, low Body Mass Index, family problems, feelings of shame about having HIV, and partner conflict. In addition, patients who lived with family and received family support had fewer depressive symptoms (43). Even though HIV treatment faces numerous obstacles, Tran, Dang suggested that access to ARV has grown in popularity in recent years which 20.2% of patients had depressive symptoms and adverse quality of life, in addition to those with depression related to physical health problems and discrimination (44). Although studies in Vietnam have assessed the level of melancholy among HIV - positive individuals, limited research has examined the relationship between depression, smoking cigarettes, and age; particularly studies use of the PHQ - 9 scale for evaluating depression. This study was conducted to determine the level of depression among HIV - positive patients and the relationship between depression, tuberculosis, smoking, and the patient's age. Based on the aforementioned purpose of study, some hypothesis was explored:

Hypothesis 1: There was a significant difference in depression levels between male and female ARV - HIV patients.

Hypothesis 2: Cigarette smoking rates among ARV - HIV Patients increased when their higher depression levels.

Hypothesis 3: ARV - HIV patients with exercise habits are more likely to use cigarettes.

Hypothesis 4: Older ARV - HIV patients are less likely to use cigarettes.

METHOD

Participants

Due to the sensitive nature of HIV-related information, the development of a sample frame was deemed impractical. Consequently, patients were conveniently picked, encompassing those who were physically present at the clinics throughout the duration of the trial until the desired sample size was achieved. A total of 400 questionnaires were sent out to HIV patients who on Antiretroviral therapy (ARV - HIV Patients). After going through the elimination process, we found that 76 of the responses were unusable for analysis because they were either incomplete or had the same answers for every question. The study project received a significant and strong response, as seen by the thorough and substantial contributions made by 324 people. This resulted in an amazing response rate of 81% (45).

Measurement

The Patient Health Questionnaire - 9 (PHQ - 9) is a self-report measure of depression made up of nine items that correspond to the DSM-IV criteria for severe depression. The PHQ - 9 is a 4 - point Likert scale, each of the nine diagnostics is scored from 0 = "Not at all" to 3 = "nearly every day". Nine categories are covered, including positive emotions, negative emotions, sleep disturbances, energy levels, appetite, feelings of failure, difficulty concentrating, sluggish speech, fidgeting, and suicidal or self-harming thoughts over the last two weeks. There was no depression (scored 0 - 4), mild depression (5 - 9), moderate depression (10 - 14), fairly severe depression (15 - 19), and severe depression (> 20), screening for major depressive disorder has been advised using a cutoff score of 10 or above on the summed-item score (46). For the sample utilized in the study, the instrument displayed good dependability Cronbach's α for the total scale was 0.92. The Vietnamese translation is referenced from the work of (47) on Vietnamese pregnant women.

The common factor model was assessed using Cronbach's alpha, composite reliability, AVE, and the HTMT criterion, as well as internal consistency reliability, convergent validity, discriminant validity, determination of coefficient and the effect sizes (48). In addition, three variables: Doing exercise, Cigarette Tuberculosis were dummy coded into 0 = "No", and 1 = "Yes".

Construct reliability

In table 1 showed that the Cronbach's alpha (CA) and the composite reliability (CR) were used to assess internal consistency reliability (49) For both CA and CR value, reliability levels between 0.60 and 0.70 are deemed "acceptable in exploratory research," while values between 0.70 and 0.90 range from "adequate to good". The values of CA and CR for the PHQ - 9 construct are shown in Table 1. It was clear that construct dependability was validated.

Table 1. The reflective measurement model

Construct and items	CR	α	AVE
Depression (PHQ - 9)	0.96	0.94	0.70

Abbreviations: CR, composite reliability; AVE, average Variance Extracted; PHQ - 9, Patient Health Questionnaire – 9.

Convergent validity

The extracted average variance is used to assess the convergent validity of measurements. The minimum acceptable AVE is 0.50 (49). As the Table 3, the AVE number exceeded 0.70, therefore, the condition of convergent validity of measurements was satisfied.

Discriminant validity

The discriminability of the reflective model was validated by HTMT value, the pairwise construct should not surpass 0.90 (49). According to Table 2, the discriminability of the reflective model was validated.

Table 2. Heterotrait - Monotrait (HTMT) Criterion of Lower Order Constructs

	Cigarette smoking	Depression	Gymnastics	Tuberculosis	Age
Cigarette smoking	-	-	-	-	-
Depression	0.13	-	-	-	-
Gymnastics	0.40	0.02	-	-	-
Tuberculosis	0.04	0.11	0.04	-	-
Age	0.18	0.03	0.17	0.16	-

Note: -, No value

Procedures

Before taking the survey, participants were given information about the terms of anonymity, confidentiality, and their responsibilities. The information sheet also covered the issue of the right to withdraw from the study. As a result, patients had the choice to drop out of the study if they were unable to continue.

The questionnaires included inquiries about the patients' gender, age, health issues, exercise routine and substance use status. The participants were told of the study's objectives and invited to contribute their information. Participants completed questionnaires and supplied self-report data while being watched over.

Ethical aspects

The study achieved the research ethics of the Department of Mental Health, Thu Duc Hospital, involving human participants was reviewed and approved by the Declaration of Helsinki and the ethical principles of the American Psychological Association (APA) regarding research involving human participants. The patients/participants provided their written informed consent to participate in this study.

Data analysis

This study utilized SPSS to analyze data. First, we examined the characteristics of participants using descriptive statistics. Then, the Mann - Whitney U test was used to compare differences between two independent groups when the dependent variable is ordinal or continuous but not normally distributed. The Kruskal - Wallis H test was

used to determine if there are statistically significant differences between three or more groups when the dependent variable is ordinal or continuous but not normally distributed (50).

The partial least squares (PLS) were approached to structural equation modeling (SEM) on testing the proposed model. PLS-SEM methodology helps test theoretically constructed models (51) and validate relatively complex models (52). Furthermore, PLS-SEM is able to analyze nonnormally distributed samples to facilities for processing relatively small sample sizes (53). Even though 5000 sample bootstrapping is commonly employed, our study only used 1000 sample methods because of the study's sample size (n = 324).

RESULTS

Following sociodemographic characteristics (as the Table 3), a total of 324 HIV patients with 248 males (76.5%) and 76 females (23.5%). The age was divided into fourth group with three adolescents (0.9%), 238 adults (73.5%), 79 middle aged adults from (24.4%) and four elderly (1.2%). Besides, there were 130 patients (40.0%) had exercise habit and 194 patients (59.9%) did not have that habit.

Table 3. Participant Demographic

Demographic Variable	Category	Frequency (%)
Gender	Female	76(23.5)
	Male	248(76.5)
Age	Adolescence	3(0.9)
	Adult	238(73.5)
	Middle aged adult	79(24.4)
	Elderly	4(1.2)
Doing exercise	Yes	130(40.0)
	No	194(59.9)
Tuberculosis disease	Yes	14(4.3)
	No	310(95.7)
Cigarette smoking	Yes	78(24.1)
	No	246(75.9)
Total		324(100)

Table 4 illustrated that nearly one fifth of the respondents were depressed (19.4%), over three fourth of respondents did not have depressive symptoms (77.8%). Among patients suffering from major depressive syndrome, 13.6% had moderate depressive symptoms, 4.6% had moderate severe depressive symptoms, and 1.2% had severe depressive symptoms.

Table 4. Severity score of depression among patients receiving ARV (n = 324)

Severity Score	n	%
Major depressive syndrome	63	19.4
Depressive symptoms		
None (0 – 4)	252	77.8
Mild (5 –9)	9	2.8
Moderate (10 – 14)	44	13.6
Moderate severe (15 – 19)	15	4.6
Severe (≥ 20)	4	1.2

To address the distribution to understand the nature of collected data, Kolmogorov–Smirnov was used to measure the normality of the collected data because the sample size was larger than 50 observations (54). Results indicated that the PHQ - 9 was non -normally distributed as the p - value is less than 0.001.

A Mann - Whitney U test was performed to evaluate whether the level of depression differed by gender. The results rejected Hypothesis 2, which indicated that there was no significant difference in the depression level between male and female patients, $z = -1.04$, $p = 0.29$. A Kruskal - Wallis's test was conducted to determine whether there is an effect of age groups on the level of depression. The results demonstrated that there was no statistically significant difference in depression between the different age groups, $\chi^2(3) = 1.64$, $p = 0.65$.

Assessment of structural model

Collinearity statistics (VIF)

Variables' VIF values were used to assess the extent of the collinearity in the structural model. The VIF values of variables are collinear when two metrics exhibit a high degree of correlation. If VIF is less than 5.00, then multicollinearity is not a critical issue in the structural model (48). The VIF values were shown in Table 5, which are all less than the threshold value of 5.00, indicating that the collinearity will not negatively impact the estimation of the structural model's path coefficients.

Table 5. Variance inflation factor (VIF) values

	Cigarette smoking	Depression	Gymnastics	Tuberculosis	Age
Cigarette smoking	-	-	-	-	-
Depression	0.001	-	-	1.00	-
Gymnastics	0.03	-	-	-	1.00
Tuberculosis		-	-	-	-
Age	1.03	-	-	1.00	-

Note: -, No value

Determination of coefficient (R2)

R2 is a measure of the prediction accuracy of the model, R2 should be more than 0.10 [55] which is a significant threshold. This study found that 19.8% variance occurred in Cigarette smoking explained by exogenous constructs.

The Predictive Relevance (Q2)

The accuracy with which the path model anticipates the initial observed values is illustrated by the Q2 values estimated by the blindfolding, an iterative method. To guarantee the model's predictive significance for a specific endogenous component, Q2 must be greater than zero (49). Cohen proposed the Q2 index table to evaluate the importance of the independent variables as follows: $Q2 < 0.02$: the prediction level is extremely small or not predictable, $0.02 \leq Q2 < 0.15$: small forecast, $0.15 \leq Q2 < 0.35$: medium forecast, $Q2 \geq 0.35$: large forecast (56). In current study Q2 values of 0.16 (medium forecast) and 0.003 (extremely small forecast) for Cigarette and Tuberculosis, respectively, are within the recommended range and demonstrate the study model's predictive validity.

The effect sizes (f2)

The researcher is able to observe the effect of each external construct on the endogenous construct by assessing the effect size. According to Cohen, f^2 value ≥ 0.02 is small; ≥ 0.15 is medium; ≥ 0.35 is large. In the current study, Exercise \rightarrow Cigarette smoking value of 0.18 (medium effect) and Depression \rightarrow Tuberculosis value of 0.1 (small effect) (56). The relationship between Exercise and Cigarette smoking yielded an effect size of 0.18, which falls within the medium range. This suggests that exercise has a moderate impact on cigarette smoking behavior. The association between Depression and Tuberculosis resulted in an effect size of 0.1, indicating a small effect. Although statistically significant, the impact of depression on tuberculosis is relatively minor.

Results of PLS-SEM analysis

Table 6. Results of PLS-SEM analysis

Path	β coefficient	t	p	95 Confidence intervals	95 BC Confidence intervals
Direct effects					
Depression -> Cigarette smoking	0.05	2.48	< 0.05	[0.01;0.10]	[0.00; 0.10]
Doing exercise-> Cigarette smoking	0.33	7.03	< 0.001	[0.26; 0.44]	[0.26; 0.44]
Age-> Cigarette smoking	-0.05	2.71	< 0.001	[-0.08; -0.01]	[-0.08; -0.01]
Depression-> Tuberculosis	-0.02	3.66	< 0.001	[-0.03; -0.01]	[-0.03; -0.01]

Table 6 found that the model explained 19.8% of the variance in the Cigarette with both direct and indirect effects of variables. Results based on 1000 bootstrapped samples depicted a presentation of direct effects from Gymnastics and Age. The result from the Table 6 revealed: a positive effect of Depression on Cigarette smoking [$\beta = 0.05$, $p < 0.05$, 95% CI = (0.01; 0.10)], a positive effect of Exercise on Cigarette [$\beta = 0.33$, $p < 0.001$, 95% CI = (0.26; 0.44)], and a negative effect of Age on Cigarette [$\beta = -0.05$, $p < 0.05$, 95% CI = (-0.08; -0.01)]. Therefore, Hypothesis 3,4,5 was supported.

Otherwise, the result of PLS-SEM analysis also showed the negative effect of Depression on Tuberculosis [$\beta = -0.02$, $p < 0.001$, 95% CI = (-0.03; -0.01)]. However, based on descriptive statistics, none of the HIV patients co-infected with tuberculosis presented with depression. Therefore, we concluded that there was no effect from Depression to Tuberculosis.

DISCUSSION

Interpretation of Key Findings

Major depression has been proven to be highly prevalent among HIV - positive patients (57). Depression influences on disease progression, mental health, and life of quality in HIV patients. The study was conducted to examine the level of depression among HIV - positive patients and the relationship between depression, tuberculosis, smoking, and age. The results showed that the one - fifth of people with HIV have moderate to severe depressive symptoms, and there is no difference between gender and age group in depression. The findings also showed that cigarette smoking significantly influenced on depressive symptoms in HIV patients. In addition, age has negatively affected smoking cigarettes among HIV patients, and depression and exercise have positively affected smoking among HIV patients.

The findings indicated that 19.4% patients who have major depression syndrome. According to Nanni, Caruso, in all stages of HIV infection, depression is the most prevalent neuropsychiatric consequence (58). Scientific evidence has supported the complexity of the causal pathways linking depression from both biological and psychological factors (58,16). Otherwise, a research of Shuter and Bernstein showed that the observed brain changes could predate the commencement of infection (60). Furthermore, Rubin and Maki proved that depression is associated with cognitive impairment in HIV patients (61).

To discuss the differences across gender (male and female) in the rate of depression, some evidences indicate the higher level of depression of HIV women when compared with men (62). Symptoms of depression in women with HIV - infected were proved to be more severe intensity than in their male counterparts (63). The finding is consistent with previous theoretical foundations for differences in depression between males and females. It's claimed that women experience depression at a rate double that of men (64). Women have a higher prevalence, incidence, and morbidity risk from depression than men (65). In addition, women are much more likely than men to ruminate about their depressive symptoms, and rumination is associated with an increased risk of recurrence

and chronicity, as well as a delayed rate of recovery (66). This is probably attributable to the emotional sensitivity and more emotional nature of female pupils and how they perceive their settings (67). However, this finding did not show any evidence of the depression levels difference across gender. There are many other socio-cultural factors and the context of HIV infection in Vietnam that have not been explored further in this study, and we expect that the hidden issue here will be answered with more detailed scientific data in the future.

This results also found that there was no difference in depression of HIV patients across age. Similarly, several studies demonstrated that depression prevalence did not differ by age (68). In contrast, some researchers have evidenced the difference between age groups in the expression of depression symptoms.. Camara, Sow and Adeoti, Dada, which convinced that younger age is a risk factor for psychiatric morbidity, and indeed, the odds of anxiety in younger HIV patients are 2.81 times higher than in older patients (26,69). The high levels of depression are related to non-adherence, failure to take HIV drugs on time, and following medication, recommendations have been provided. And Ghidei, Simone proved that adherence to ARV was stronger among older compared to their younger counterparts (70). In addition, practically, there was much research that illustrate the difference in depression prevalence age groups (71).

Hypothesis 2 also showed that cigarette smoking was convinced significantly associated with depressive symptoms in HIV patients (72). Many works demonstrated that people with depression have a greater propensity to smoke, smoke more cigarettes daily, and have a lower chance of effectively quitting smoking (73). The results of study showed that HIV patients with greater depression levels got higher using cigarette possibility (hypothesis 2). Previous research indicated HIV smokers who were worried about their health actually found that cigarettes helped them unwind and deal with unpleasant emotions including anxiety, rage, and despair (20). Besides anxiety also was found to have a significant association with cigarette smoking in a study on the link between smoking and anxiety and depression (74). Otherwise, according to Bénard, Bonnet, regular and occasional smokers among HIV patients had a considerably higher frequency of depressed symptoms than never or never - ever smokers (75). In addition, Kowal, Overduin also affirmed that HIV - positive smokers who experience depressive symptoms have been shown to have decreased mental functioning, reduced sense of well - being, and adherence to antiretroviral medication (76).

Older HIV patients are less likely to smoke, this result explains hypothesis 4. Some previous research have shown opposite results, in which older HIV - infected individuals were proved to be more likely to be heavy smokers than their younger counterparts (16, 77). On the other hand, a French study showed that patients who had been living with HIV for longer and were older were more likely to try to quit smoking (78). Furthermore, our participants were HIV patients on ARV, whereas cigarette has been demonstrated to adversely affect ARV treatment processes (79), and smoking may reduce the efficacy of ARV drugs (80). Additionally, in some studies, smoking has been identified as a predictor of nonadherence to ARV in HIV - infected patients (81).

In addition, the study's results indicated a positive effect of exercise on smoking among HIV patients receiving ARV (hypothesis 3). Similar to this study's findings, Ussher, Taylor found that only one out of thirteen trials substantially reduced smoking twelve months after follow – up (82). In contrast, in various short - term human clinical studies, more evidence has shown that exercise lowers smoking and nicotine addiction (83). Physical activity or exercise has been investigated as a potential treatment for substance dependence and smoking cessation (39). Inconsistent adherence to the exercise program as directed by health care professionals and treating physicians and other factors (such as duration, intensity, and duration of exercise) could explain the effect of exercise on smoking in this study. According to Wang, Wang, a schedule of moderate to strong aerobic exercise was effective in treating individuals with substance use disorders and smoking disorders over the long term (84). The effectiveness of exercise in reducing smoking depends on the correlation between exercise intensity and individuals' smoking status. People who smoke frequently require the exercise of moderate to high intensity to be effective, whereas less smokers (fourteen or fifteen cigarettes per day) require exercise of low to moderate intensity to be effective (85). Katomeri and Taylor also found that those who smoke less and do high - intensity exercise that causes stress responses have fewer positive effects on behavior and cravings than those who engage in moderate exercise (85). Recent studies (86) have discussed the impact of impulsivity on smoking cessation (including adherence to treatment plans and activity/exercise plans). HIV patients on ARV must adhere to the health care

provider's exercise plan to effectively reduce smoking. HIV patients must attend monthly group education sessions conducted and supervised by a medical professional to monitor their progress and modify the intensity of their exercise program.

Limitation and implication

The findings of this study have contributed to theory and implements. Depression is more prevalent in individuals with HIV infection or who have progressed to AIDS, so HIV patients should be screened for depression for a comprehensive evaluation and supportive treatment. The study also found an association between tuberculosis, cigarette smoking, and depression in people with HIV. The research suggests that HIV-infected patients with depression and comorbidity must consider the diagnosis of the influence of factors on depression, make a diagnosis, and have appropriate treatment methods. Previous research has shown that psychiatric disorders and comorbidity affect the progression of HIV disease. Clinicians, nurses, psychologists, and other health professionals must understand and identify the associated factors and determinants of depression in HIV/AIDS-infected patients. In addition, the diagnosis of depression disorder is complex and challenging in HIV patients because the symptoms of depression are similar to those of HIV such as pain, fatigue, insomnia, anorexia, and cognitive decline (87). Therefore, clinicians and psychologists should be careful when diagnosing and evaluating depressive disorders in HIV-infected patients. Clinicians and psychologists should be highlighted the important role of depression in HIV disease progression and mortality (88) to encourage positive treatment and adherence in patients.

However, the research still has some limitations. This is a cross - sectional study, the findings are not considered as a cause and result of research; future research should be conducted by experimental, in - depth interview methods. Studies also need to determine the chronological order of the relationship between smoking, tuberculosis, depression, and difficulty in treatment adherence in HIV - infected people to assess the influence of factors on depression accurately. Besides that, the study was self - reported; the results may be subjective and may not accurately reflect the patient's health status. Further studies should collect relatives' opinions for the most objective and effective feedback. In addition, demographic questions regarding HIV comorbidity are reported using Yes/No questions, which do not accurately reflect the level of health experienced by people with HIV. Future research assessing the impacts of commodities on depression in HIV - infected individuals ought to depend on physician diagnoses.

CONCLUSION

HIV/AIDS is a series of problems that cause problems in the human immune system, which in change influence social - cultural issues and the health care system. In addition to the negative effects on the patient's physical health, HIV/AIDS negatively affects the patient's mental health and social interaction. This study examined the level of melancholy in HIV patients receiving ART and the association between depression, smoking, tuberculosis, and age. The results of the study revealed that 19.4% of HIV patients exhibited moderate to severe depressive symptoms. In addition, research has demonstrated that depression and exercise positively affect smoking among HIV patients and that elderly HIV patients are less likely to smoke. Since some depressive symptoms are similar to those of HIV, the study suggests that HIV - positive individuals require an accurate diagnosis and evaluation of the symptoms of depression. Consider implementing individualized exercise intensity programs to help HIV patients quit smoking. The study also suggested the need for patient monitoring, adherence monitoring, and exercise planning to assess and modify HIV patients' treatment.

AUTHOR'S CONTRIBUTION STATEMENT

All authors contributed equally to the conception and design of the study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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