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Research Article

The Correlation Between Antiretroviral (ARV) Adherence and Coping Strategies on the Immune Status of People Living with HIV (PLHIV)

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Abstract: Acquired Immune Deficiency Syndrome (AIDS), caused by the Human Immunodeficiency Virus (HIV), remains a significant global health issue, with an estimated 39.9 million people living with HIV (PLHIV) worldwide. HIV damages the immune system, particularly CD4 T cells, making patients susceptible to opportunistic infections. Given this major impact, immune status is a primary focus for PLHIV, where two key factors adherence to Antiretroviral (ARV) therapy and coping strategies play a vital role. ARV adherence is proven to suppress viral replication and restore CD4 cell count, while adaptive coping strategies assist in managing stress that can weaken the immune response. To determine the correlation between ARV adherence and coping strategies on the immune status of people living with HIV (PLHIV). This study used a quantitative research type with a cross-sectional design. The sample consisted of 64 respondents. Sampling was determined using the Slovin formula technique. The data obtained were analyzed using the Spearman's Rho correlation test. The results of the Spearman's Rho correlation test indicated a correlation between antiretroviral (ARV) adherence and coping strategies on the immune status of people living with HIV (PLHIV). There is a correlation between antiretroviral (ARV) adherence and coping strategies on the immune status of people living with HIV (PLHIV).

Keywords: ARV Adherence; Coping Strategies; HIV/AIDS; Immune Status; PLHIV.

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1. Introduction

AIDS represents a humanistic perspective on the global challenge of Acquired Immunodeficiency Syndrome, commonly abbreviated as AIDS, which fundamentally results from a drastic weakening of the immune system triggered by the Human Immunodeficiency Virus (HIV). To illustrate, HIV deliberately attacks the body's most critical protective forces known as CD4 T-cells. These cells normally stand on the front line, working tirelessly to keep the body healthy. When this infection is not properly managed, it can progress to AIDS. At this stage, the body becomes so vulnerable that it is susceptible to a wide range of opportunistic infections and other serious diseases that a healthy immune system would ordinarily be able to resist. However, the impact extends far beyond physical conditions alone. HIV/AIDS disrupts the entire life of those affected: their mental health, social relationships, and economic stability are profoundly influenced (Pranoto, 2020). This constitutes a deep and urgent global problem that requires comprehensive attention and support, particularly in developing countries such as Indonesia.

Although significant progress has been achieved in the prevention and treatment of HIV/AIDS, this pandemic remains a global public health issue at both regional and

international levels in 2024. Globally, despite a decline in new HIV infections and AIDS-related deaths, the number of people living with HIV remains substantial, with millions of individuals requiring continuous access to antiretroviral therapy (ART). Limited access to prevention services, testing, and treatment continues to be a major barrier, especially in resource-constrained settings and among key vulnerable populations. Regionally, Sub-Saharan Africa continues to bear the greatest burden of the pandemic, accounting for the majority of new cases and AIDS-related deaths, although encouraging declines have been observed in several countries. In contrast, certain regions such as Eastern Europe and Central Asia have experienced increases in new cases, often driven by factors such as injecting drug use and the absence of supportive public policies. These trends underscore the importance of sustained investment in a holistic HIV response grounded in human rights principles and locally oriented strategies to achieve the global target of ending the AIDS epidemic by 2030 (Fitriani, Indrawati, & Puspasari, 2022).

Referring to the most recent data provided by the World Health Organization (WHO) for 2023 and projections for 2024 (as of July 2025): Global HIV/AIDS Data (WHO/UNAIDS Estimates, up to the end of 2023 / 2024 projections). The number of people living with HIV (PLHIV) worldwide at the end of 2023 was approximately 39.9 million [range: 36.1 million–44.6 million] individuals. Adults (aged 15 years and older): 38.6 million [34.9 million–43.1 million]. New HIV infections in 2023 were estimated at approximately 1.3 million [range: 1.0 million–1.7 million] individuals. AIDS-related deaths in 2023 were estimated at approximately 630,000 [range: 500,000–820,000]. Adults: 560,000 [430,000–730,000]. The number of people receiving antiretroviral therapy (ART) in 2023 was approximately 30.7 million [range: 27.0 million–31.9 million] people ((WHO), 2024).

Immune status among people living with HIV/AIDS (PLHIV) is strongly influenced by the level of adherence to antiretroviral therapy (ARV) and the coping strategies they employ. HIV directly attacks the immune system, particularly CD4 cells, which play a crucial role in combating infections. A significant decline in CD4 cell counts markedly reduces the body's ability to fight infections, rendering patients more susceptible to opportunistic infections such as tuberculosis, pneumonia, and cancers such as Kaposi's sarcoma. Moreover, if patients do not consistently adhere to antiretroviral therapy (ARV), viral load may increase and accelerate damage to the immune system (Glanz & Bishop, 2021). Psychological factors and stress also play a role, as ineffective coping strategies can elevate stress hormone levels such as cortisol, which in turn further weakens immune responses. Thus, the primary problem in the immune status of HIV patients lies in the complex decline of immune system function, caused by HIV infection itself and exacerbated by supporting factors such as treatment adherence and stress management.

Regular use of ARV therapy has a direct impact on improving immune status. ARVs work by suppressing viral replication in the body, thereby reducing viral load. With a lower viral load, the immune system has an opportunity to restore normal function, including increasing CD4 cell counts. Research indicates that HIV/AIDS patients who adhere to ARV therapy have a greater likelihood of achieving higher CD4 counts compared to those who are non-adherent (Pranoto, 2020).

Adherence to ARV therapy is a key factor in suppressing HIV replication, which in turn helps maintain the stability of the immune system. By taking ARV medications regularly and according to recommended dosages, PLHIV can maintain or increase CD4 cell counts, thereby enhancing the body's capacity to combat opportunistic infections and other HIV-related complications (Pranoto, 2020).

On the other hand, coping strategies also play a crucial role in supporting immune status. Adaptive coping strategies, such as confronting problems directly, seeking social support, and maintaining a healthy lifestyle, can help PLHIV manage the stress associated with chronic illness. Effective stress management contributes to a reduction in the release of stress hormones such as cortisol, which, when excessive, can weaken immune responses. Conversely, maladaptive coping strategies such as avoidance, substance use, or social withdrawal can exacerbate psychological and physical conditions, negatively affecting immune status. In addition, support from family members, communities, and healthcare professionals is essential in maintaining adherence to ARV therapy. This support assists PLHIV in coping

with social stigma, psychological pressure, and economic challenges that often constitute barriers to treatment (Helmiato & AG, 2021). Consistent support tends to increase motivation among PLHIV to adhere to ARV therapy and adopt adaptive coping strategies, thereby collectively contributing to improved immune status and quality of life. Factors such as health education, accessibility of therapy, and stigma reduction must also be prioritized in efforts to enhance immune status among PLHIV. Educational programs that explain the importance of ARV therapy and its impact on the immune system can increase patient awareness of the long-term benefits of treatment adherence (Pranoto, 2020).

This study aims to analyze the relationship between adherence to ARV use and coping strategies in relation to the immune status of patients with HIV/AIDS. By understanding the factors that influence immune status and coping strategies, it is expected that more effective approaches can be developed to improve care and adherence to ARV therapy among PLHIV. The results of this study are anticipated to make a significant contribution to the formulation of more integrated HIV/AIDS management strategies, combining medical aspects with psychosocial adherence to enhance the quality of life of PLHIV and support them in leading better lives despite being diagnosed with HIV/AIDS (Berman, 2021).

2. Literature Review

HIV/AIDS

Definition

Acquired Immunodeficiency Syndrome (AIDS) is a syndrome resulting from severe cellular immunodeficiency with no other known cause, characterized by life-threatening opportunistic infections and malignancies. The syndrome develops gradually, typically 5–10 years after initial infection with the Human Immunodeficiency Virus (HIV). Individuals living with HIV are classified into two categories: those who have developed clinical symptoms (AIDS-positive) and those who are infected with HIV but remain asymptomatic (AIDS-negative). Epidemiologically, asymptomatic HIV infections are far more prevalent than AIDS cases; however, HIV infection may progress to widespread immunological dysfunction and diverse clinical manifestations. AIDS is considered highly fatal, with a reported case fatality rate approaching 100% within five years after diagnosis if untreated (Suensen, 2021).

Etiology

AIDS is caused by the Human Immunodeficiency Virus (HIV), a retrovirus first isolated in 1983 in France and internationally recognized as HIV in 1986 following scientific consensus (Adiningsih, Fitriani, & Hidayat, 2021). HIV is an RNA virus that primarily targets CD4 T-lymphocytes by binding to CD4 receptors, enabling viral entry and replication. Although HIV may remain latent within host cells for extended periods, it remains transmissible throughout the infected individual's lifetime (Berman, 2021). Structurally, HIV consists of a core containing RNA and enzymes such as reverse transcriptase, and an outer envelope composed of lipids and glycoproteins (gp120 and gp41). The virus is environmentally sensitive and easily inactivated outside the human body.

Pathogenesis and Pathophysiology

HIV infection leads to progressive immune system deterioration by destroying CD4 cells, which play a central role in immune regulation. Through reverse transcription and integration into host DNA, HIV replicates extensively and gradually depletes CD4 cells, resulting in immunosuppression and increased susceptibility to opportunistic infections and malignancies. Clinically, HIV infection progresses through acute, chronic (latent), and AIDS stages, with AIDS defined by CD4 counts below 200 cells/μL and the presence of severe opportunistic conditions. Antiretroviral therapy (ARV) suppresses viral replication, slows disease progression, partially restores immune function, and significantly improves life expectancy and quality of life, although it does not cure HIV (Suensen, 2021; Alivia Pramesti, 2023).

Clinical Manifestations

The clinical presentation of HIV varies according to disease stage. Acute infection often presents with nonspecific flu-like symptoms, while the latent phase may be asymptomatic for years despite ongoing viral replication. Without treatment, progression to AIDS results in severe opportunistic infections such as Pneumocystis jirovecii pneumonia, tuberculosis, toxoplasmosis, chronic diarrhea, and HIV-associated malignancies including

Kaposi's sarcoma and non-Hodgkin lymphoma. Systemic symptoms such as weight loss, prolonged fever, night sweats, and extreme fatigue are common in advanced disease (Suensen, 2021).

Diagnostic Evaluation

HIV diagnosis involves a stepwise approach including screening tests (e.g., ELISA), confirmatory tests (Western blot, immunoblot, or nucleic acid testing), rapid tests for specific settings, viral load measurement to assess viral activity, CD4 cell counts to evaluate immune status, and comprehensive pre- and post-test counseling to ensure patient understanding and prevention education.

Signs and Symptoms

HIV infection initially allows viral replication without immediate cell death, leading to a prolonged incubation period ranging from months to over ten years. Progressive immune damage results in vulnerability to bacterial, fungal, protozoal infections, malignancies, and potential neurological impairment. Common clinical symptoms include chronic fatigue, significant weight loss, recurrent fever and night sweats, persistent diarrhea, oral candidiasis, lymphadenopathy, pneumonia, and skin cancers (Helmiati & Ag, 2021).

Antiretroviral Therapy (ARV)

Antiretroviral therapy is the cornerstone of HIV/AIDS management, aiming to suppress viral replication, preserve immune function, reduce transmission risk, and prevent disease-related complications. Treatment success is highly dependent on patient adherence to prescribed regimens. Non-adherence remains a major cause of therapeutic failure and drug resistance, highlighting the importance of continuous monitoring, evaluation, and patient support to ensure long-term treatment effectiveness (Helmiati & Ag, 2021).

Coping Strategies

Coping is defined as a dynamic cognitive and behavioral process through which individuals appraise and manage situations perceived as stressful. According to Lazarus and Folkman (1984), coping involves two key stages: primary appraisal, in which individuals evaluate whether a situation poses a threat, loss, or challenge to their well-being, and secondary appraisal, where they assess available resources and capacities to address the stressor. In the context of HIV/AIDS, coping strategies are particularly crucial, as patients must confront complex challenges such as a life-altering diagnosis, long-term treatment demands, and persistent social stigma. Coping mechanisms may be oriented toward problem-solving, emotional regulation, or positive adaptation, each contributing to psychological resilience and physical well-being (Taylor, 2024).

Broadly, coping strategies among individuals living with HIV/AIDS include problem-focused coping, emotion-focused coping, and the utilization of social and mental health support. Problem-focused coping emphasizes direct efforts to manage stressors, such as acquiring medical knowledge, adhering to antiretroviral therapy, and engaging with healthcare professionals. Emotion-focused coping aims to regulate emotional distress through social support, counseling, spiritual practices, or relaxation techniques, which may positively influence immune functioning, particularly during periods of heightened stress. Social support from family, peers, and the community plays a vital role in enhancing mental health, reducing stigma, and fostering self-acceptance, thereby improving overall quality of life for people living with HIV/AIDS.

The effectiveness of coping strategies is shaped by both internal and external factors. Internal factors include physical health, personal beliefs, problem-solving abilities, social skills, self-concept, and personality traits, while external factors encompass education, financial resources, quality of life, and social support systems (Lazarus & Folkman, 2020; Taylor, 2024). Good physical health enables individuals to mobilize adequate energy to manage stress, whereas positive beliefs and adaptive personality traits support constructive coping responses. Conversely, limitations in health, resources, or social support may hinder effective coping. In general, coping strategies are categorized into those focused on problem resolution and those centered on emotional regulation, both of which interact to determine an individual's capacity to manage stress and maintain psychological balance in the face of chronic illness (WHO, 2021; Alivia Pramesti, 2023).

Adherence to ARV Treatment

Antiretroviral therapy (ARV) is currently regarded as the most effective treatment for individuals infected with Human Immunodeficiency Virus (HIV), aiming to suppress viral replication, reduce viral load to undetectable levels, increase CD4 cell counts, and prevent opportunistic infections, although it does not eradicate the virus (Murray et al., 2020; Jiang et al., 2021). National and international guidelines emphasize that ARV should be initiated in all individuals diagnosed with HIV/AIDS, regardless of clinical stage or CD4 count, including adults, adolescents, and children (Ministry of Health of the Republic of Indonesia, 2020). The primary objectives of ARV therapy include maintaining immune function, improving quality of life, and reducing HIV-related morbidity and mortality. ARV regimens are administered in structured lines of therapy first, second, and third line typically consisting of combinations of nucleoside reverse-transcriptase inhibitors (NRTIs) with either non-nucleoside reverse-transcriptase inhibitors (NNRTIs), integrase strand transfer inhibitors (INSTIs), or protease inhibitors (PIs) (Murray et al., 2020; Jiang et al., 2021).

Adherence to ARV therapy is a critical determinant of treatment success and is influenced by multiple interrelated factors. Internal factors include intrinsic motivation, personal beliefs, and comprehensive understanding of ARV benefits, which are strongly associated with sustained adherence (Purnama & Setiawan, 2020). External factors such as the availability and accessibility of ARV services, financial capacity to cover laboratory tests and opportunistic infection treatment, and the quality of healthcare delivery also play a significant role in adherence (Prasetyo et al., 2021). Social support from family members, peers, and healthcare providers has been shown to substantially enhance treatment consistency, with family members often acting as treatment supervisors to ensure regular medication intake (Hidayat & Fitria, 2021). Additional sociodemographic factors, including education, employment status, and place of residence, may influence adherence, whereas age, sex, and distance to healthcare facilities appear to have less consistent effects (Indrawati et al., 2020).

Long-term and consistent use of ARV has been proven to significantly reduce HIV-related morbidity and mortality, prevent immune system deterioration, and lower the risk of HIV transmission, particularly when viral load is suppressed to undetectable levels (Rohmawati et al., 2020). Nevertheless, adherence may be challenged by adverse drug effects, which frequently include nausea, dizziness, skin rashes, and central nervous system symptoms, often occurring in the early stages of treatment and potentially leading to treatment interruption if not properly managed (Puspasari et al., 2020). Some patients combine ARV therapy with herbal remedies to alleviate side effects; however, such practices may alter ARV pharmacokinetics and increase the risk of toxicity or treatment failure, despite potential antioxidant benefits of certain herbal preparations (Fitriani et al., 2022). Standard ARV regimens consist of triple-drug combinations, most commonly involving two NRTIs with an INSTI, NNRTI, or PI, and careful clinical monitoring is essential to maintain adherence, minimize adverse effects, and ensure sustained therapeutic effectiveness (Karyadi, 2020; Adiningsih et al., 2021; Sebayang, 2020).

Immunity Status

Immune status refers to the overall capacity of the body's immune system to defend against infections, diseases, and other pathogenic threats, a condition shaped by health history, nutrition, stress levels, lifestyle, and chronic illnesses. In individuals living with HIV/AIDS, immune status is primarily determined by the concentration of CD4+ T lymphocytes, which play a central role in coordinating immune responses. A decline in CD4+ cell counts significantly increases vulnerability to opportunistic infections and other serious complications, making continuous laboratory monitoring and strict adherence to antiretroviral therapy (ARV) essential for maintaining immune function and quality of life. The immune system itself is a highly complex network composed of immune cells, organs, and molecular mediators that collectively recognize and eliminate harmful pathogens (Snyder et al., 2021), and its failure can lead to chronic infections and malignancies (Barton et al., 2020).

Structurally, the immune system consists of specialized organs such as the bone marrow, lymph nodes, and spleen, which support the production, maturation, and activation of immune cells (He et al., 2020). These organs enable effective interaction among immune

components, ensuring rapid and coordinated responses to infection. At the cellular level, immune defense is mediated by various leukocytes, including T cells, B cells, macrophages, and neutrophils, each with distinct yet interdependent functions. B cells produce antibodies that specifically recognize and neutralize pathogens, while T cells regulate immune activity and directly destroy infected or malignant cells. Effective immunity relies not only on the presence of these cells but also on their communication and coordination, which underpins immunological memory and sustained protection against recurrent infections.

Functionally, human immunity operates through two integrated systems: innate and adaptive immunity. Innate immunity provides immediate, non-specific defense through physical barriers, phagocytic cells, and inflammatory mediators (Jones & Davis, 2022), whereas adaptive immunity develops after pathogen exposure and is characterized by specificity and long-term memory (Brown et al., 2023). In the context of HIV infection, the virus directly compromises adaptive immunity by targeting CD4+ T cells, progressively weakening immune regulation and defense. ARV therapy is therefore critical, as it suppresses viral replication, reduces viral load, and allows partial restoration of CD4+ cell counts, thereby improving immune status. Empirical evidence demonstrates that high adherence to ARV is strongly associated with immune recovery and improved health outcomes among people living with HIV (Pranoto, 2020). Moreover, psychosocial factors such as social support and effective coping strategies play a significant indirect role in immune health, as reduced stress and stigma contribute to better treatment adherence and overall immune resilience (Direktorat Jenderal Pencegahan dan Pengendalian Penyakit, 2021)

Theoretical Framework

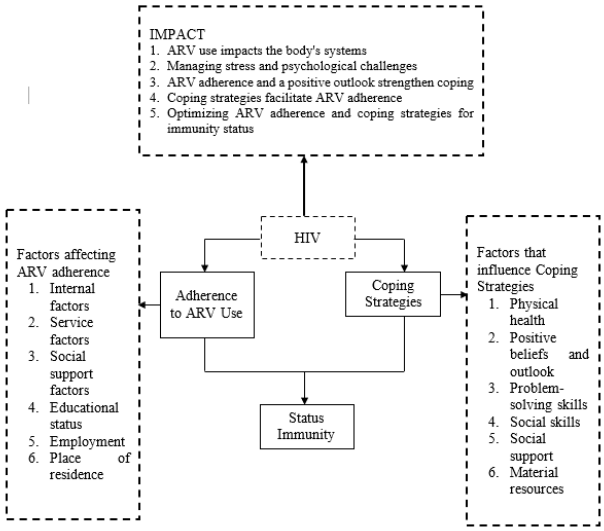

Figure 1. Research Theoretical Framework.

3. Research Method

This study is grounded in a conceptual framework that explains the interrelationships between independent and dependent variables as an abstraction of empirical reality, enabling systematic communication and theoretical interpretation of the phenomena under investigation (Nursalam, 2021). Using a cross-sectional design, the research examines the association between antiretroviral therapy (ARV) adherence and coping strategies with immune status among people living with HIV at a single point in time. Data were collected through structured questionnaires to efficiently capture patterns of interaction among variables, positioning immune status as the outcome influenced by treatment adherence and psychosocial coping. The population comprised 180 HIV/AIDS patients receiving care at Puskesmas Poncol, and a sample of 64 respondents was determined using the Slovin formula with a 10% margin of error and selected through accidental sampling, in accordance with established methodological principles (Sugiyono, 2021).

Operational definitions were applied to ensure precise and measurable variables, encompassing ARV adherence, coping strategies, and immune status, each assessed using validated and reliable instruments (Sugiyono, 2021). ARV adherence was measured using the Morisky Medication Adherence Scale (MMAS-8), coping strategies were assessed through the

Brief COPE Inventory, and immune status was evaluated using the Immune Status Questionnaire (ISQ), all of which have demonstrated strong psychometric properties in prior studies (Rahmawati et al., 2021; Saputra, 2022; Fitriani, 2023). Validity testing confirmed that all instruments met accepted statistical thresholds, including Pearson Product Moment correlations and Content Validity Index values above recommended standards, while reliability testing yielded Cronbach's alpha coefficients ranging from 0.88 to 0.95, indicating high to very high internal consistency (Sugiyono, 2021). These findings support the suitability of the instruments for accurately measuring behavioral, psychological, and immunological dimensions among people living with HIV.

Data collection followed rigorous ethical and administrative procedures, including approval from an institutional ethics committee and relevant health authorities, prior to implementation at Puskesmas Poncol. Primary data were obtained via online questionnaires distributed through Google Forms, complemented by secondary data from medical records, and subsequently processed through systematic stages of editing, coding, scoring, tabulating, and data cleaning to ensure accuracy and analytical readiness. Statistical analysis comprised univariate analysis to describe respondent characteristics and variable distributions, and bivariate analysis to test associations among ordinal variables. Given the ordinal scale of ARV adherence, coping strategies, and immune status, Spearman's rank correlation test was employed to examine the relationships between independent and dependent variables, providing an appropriate and robust analytical approach for assessing the study hypotheses (Sugiyono, 2021).

4. Results and Discussion

This study was conducted from August 6, 2025 to October 21, 2025 at Puskesmas Poncol, Semarang City. The total number of respondents was 64 people, consisting of both male and female individuals living with HIV. This chapter presents the research findings obtained from data collection using previously prepared research instruments in the form of questionnaires. The collected data were then analyzed to address the research questions and to test the established hypotheses. This section describes respondent characteristics, the results of descriptive analysis for each variable, and the results of testing the relationships between antiretroviral (ARV) adherence, coping strategies, and immune status among people living with HIV (PLHIV), using Spearman's rho correlation test. The analysis was conducted to determine the strength of the relationships among the studied variables and their implications for respondents' health conditions.

Respondent Characteristics

The respondents used in this study were HIV patients at the Poncol Community Health Center in Semarang City. There were 64 respondents in this study, with details on their age, gender, highest level of education, and occupation.

Table 1. Frequency distribution of respondents based on age at the Poncol Community Health Center in Semarang City.

Age	Frequency (f)	Percentage (%)
17-25 (late adolescence)	2	3,1%
26-35 (early adulthood)	29	45,3%
36-45 (late adulthood)	30	46,9%
46-55 (early elderly)	3	4,7%
Total	64	100%

Table 1 shows the age of respondents and the age distribution of ODHIV from 64 respondents. The largest number of respondents were in the late adult category of 36-45 years old with 30 respondents or (46.9%), early adulthood (26-35 years) with 29 respondents (45.3%), early elderly (46-55 years) with 3 respondents (4.7%), and late adolescence (17-25 years) with 2 respondents (3.1%).

Table 2. Frequency distribution of respondents based on gender at the Poncol Community Health Center in Semarang City.

Gender	Frequency (f)	Percentage (%)
Male	44	68.80%
Female	20	31.30%
Total	64	100%

Table 2 shows that there were 44 male respondents (68.80%) and 20 female respondents (31.30%).

Table 3. Frequency distribution of respondents based on highest level of education at the Poncol Community Health Center in Semarang City.

Education Level	Frequency (f)	Percentage (%)
Junior High School	7	10.9%
Senior High School	40	62.5%
Higher Education	17	26.6%
Total	64	100%

Table 3 shows that the highest level of education of respondents with junior high school education was 7 respondents or (10.9%), senior high school education was 40 respondents or (62.5%), and college education was 17 respondents or (26.6%).

Table 4. Frequency distribution of respondents based on their last occupation at the Poncol Community Health Center in Semarang City.

Occupation	Frequency (f)	Percentage (%)
Unemployed	12	18.8%
Homemaker	3	4.7%
Self-Employed	4	6.3%
Private-Sector Employee	44	68.8%
Laborer	1	1.6%
Total	64	100%

Table 4 shows that the types of employment of respondents were as follows: not working, 12 respondents or (18.8%); housewife, 3 respondents or (4.7%); entrepreneur, 4 respondents or (6.3%); private employee, 44 respondents or (68.8%); and laborers numbered 1 respondent or (1.6%).

Research Variables

Table 5. Frequency distribution of respondents based on ARV adherence at the Poncol Community Health Center in Semarang City.

Variable ARV Adherence	Frequency (f)	Percentage (%)
Low	24	37.5%
Moderate	28	43.8%
High	12	18.8%
Total	64	100%

Table 5 shows that the number of respondents with low antiretroviral (ARV) adherence was 24 respondents or (37.5%), moderate adherence was 28 respondents or (43.8%), and high adherence was 12 respondents or (18.8%).

Table 6. Frequency distribution of respondents based on coping strategies at the Poncol Community Health Center in Semarang City.

Variable Coping Strategy	Frequency (f)	Percentage (%)
Low	22	34.4%
Moderate	22	34.4%
High	20	31.3%
Total	64	100%

Table 6 shows that the number of respondents in the low coping strategy category was 22 respondents or (34.4%), the moderate category was 22 respondents or (34.4%), and the high category was 20 respondents or (31.3%).

Table 7. Frequency distribution of respondents based on immunity status at the Poncol Community Health Center in Semarang City.

Variable Immune Status	Frequency (f)	Percentage (%)
Poor	23	35.9%
Fair	24	37.5%
Good	17	26.6%
Total	64	100%

Table 4.7 shows that the number of respondents with poor immunity status was 23 respondents or (35.9%), those with adequate immunity status was 24 respondents or (37.5%), and those with good immunity status was 17 respondents or (26.6%).

Bivariate Analysis

Bivariate analysis was used to determine whether there was a relationship between antiretroviral (ARV) adherence and coping strategies on the immune status of people living with HIV (PLHIV). Bivariate analysis in this study was performed using Spearman's rho correlation test.

Table 8. Relationship between ARV adherence and immune status at the Poncol Community Health Center in Semarang City.

	Immunity Strategy					
	Poor	**Fair**	**Good**	**Total**	**r**	***p***
Low	19	0	5	**24**		
ARV Moderate	3	24	1	28	0,623	0,001
Adherence High	1	0	11	12		
Total	23	24	17	64		

Based on Table 8, the results of Spearman's rho correlation test on the variable of antiretroviral (ARV) adherence with immunity status obtained a Spearman's rho correlation coefficient value of r 0.623, indicating that the direction of the correlation is unidirectional with a strong correlation strength. A significance value of p 0.000 was obtained for 64 respondents, indicating that the pre-value < 0.001, so the correlation between ARV adherence and immunity status is significant.

Table 9. Relationship between coping strategies and immunity status at the Poncol Community Health Center in Semarang City.

	Immunity Strategy					
	Poor	**Fair**	**Good**	**Total**	**r**	***p***
Low	18	2	2	**22**		
Strategy Moderate	2	20	0	22	0,682	0,001
Coping High	3	2	12	20		
Total	23	24	17	64		

Based on Table 9, the results of Spearman's rho correlation test on the coping strategy variable with immunity status obtained a Spearman's rho correlation coefficient value of r 0.682, indicating that the direction of the correlation is unidirectional with a strong correlation strength. A significance value of p 0.000 was obtained for the 64 respondents, indicating that the pre-value < 0.001, so the correlation between coping strategies and immunity status is significant.

Adherence to Antiretroviral Therapy (ART)

Adherence to antiretroviral therapy (ART) is a fundamental pillar in the success of treatment aimed at suppressing viral replication and restoring immune status. Therapy can be considered optimal when medication intake exceeds 95% of the total prescribed doses (Windiramadhan, Carsita, & Rahayu, 2024). The data show that 81.3% of respondents were classified as having moderate or low adherence, which may lead to drug resistance and a decline in quality of life. Clinically, consistent and adherent ART use can suppress viral load, which directly correlates with a favorable immune status (Febriani, Lukas, & Murtiani, 2025).

Within the transactional model of stress and coping, low and moderate non-adherence is often a manifestation of dysfunctional coping strategies. In such circumstances, low to moderate levels of adherence have significant implications for immune status, triggering drug resistance and opportunistic infections, thereby necessitating more intensive interventions to maintain optimal immune status (Dahliyanti, Khairiah, Nuraidah, & Murtiani, 2022).

Coping Strategies

According to stress and coping theory, coping represents cognitive and behavioral efforts to manage internal or external demands by utilizing available personal resources (Senjaya, Hernawaty, Hendrawati, & DA, 2022). In the context of people living with HIV (PLHIV), adaptive coping is essential to support behaviors that ultimately lead to medication adherence. However, the finding that 68.8% of respondents were in the low and moderate categories indicates a predominance of dysfunctional coping strategies, such as denial and inadequate self-management. Consequently, negative coping mechanisms may result in decreased immunity and a deterioration of both physical and psychological conditions (Jusriana, Gobel, & Arman, 2020).

Immune Status

The high proportion of poor and moderate immune status observed in the data, amounting to 81.3%, indicates an inability to control viral load, thereby making it difficult to maintain immune levels. This condition is inconsistent with the key principle of suppressing viral replication and effectively enhancing immune status (Irwan, Gani, & Mokodompis, 2025). Therefore, nursing interventions should prioritize improving ART adherence, particularly among specific age groups, through comprehensive education on the importance of medication compliance and the strengthening of adaptive coping strategies to facilitate a transition toward good immune status. This aligns with the theory that higher levels of adaptive coping and adherence are associated with a significant improvement in immune function (Febriani, Lukas, & Murtiani, 2025).

The Relationship between Adherence to Antiretroviral (ARV) Use and Immune Status among People Living with HIV (PLHIV)

The results of the bivariate analysis in this study, using Spearman's rho correlation test, demonstrate a significant and strong relationship between adherence to antiretroviral (ARV) use and immune status among PLHIV at Poncol Public Health Center, Semarang City. The correlation coefficient value of $r = 0.623$ indicates a positive relationship with strong correlation strength, supported by a significance value of $p < 0.001$, thereby firmly confirming that the higher the level of ARV adherence, the better the immune status of respondents, and conversely, the lower the level of ARV adherence, the poorer the immune status of respondents.

This strong relationship is consistent with the fundamental theory of therapy for people living with HIV/AIDS, in which the primary objective of ARV administration is to optimally suppress the replication of the Human Immunodeficiency Virus (HIV). Optimal ARV adherence, ideally at a level of > 95%, ultimately leads to an improvement in immune status. (Senjaya, Hernawaty, Hendrawati, & DA, 2022) The data indicate that 81.3% of respondents with moderate and low adherence correlate with 73.4% of respondents who have poor and fair immune status, demonstrating that low adherence is a principal indicator of failure in immune recovery. Research consistently finds a significant relationship between ARV adherence and immune status, where non-adherence increases the risk of opportunistic infections and accelerates progression toward AIDS. (Irwan, Gani, & Mokodompis, 2025)

Poor ARV adherence, as evidenced by data showing that 81.3% of respondents fall into the low and moderate categories, represents a key psychosocial indicator influencing an individual's ability to maintain the complex behavior of taking ARV regularly. (Jusriana, Gobel, & Arman, 2020) This study shows that non-adherence to ARV consumption, particularly when ARV treatment is not taken routinely, automatically weakens the system both physically and psychologically, which indirectly undermines immune status. (Dahliyanti, Khairiah, Nuraidah, & Murtiani, 2022)

The strength of this relationship lies in the pharmacodynamics of ARV. Optimal adherence ensures that drug concentrations in the blood remain consistently above the threshold required to maximally suppress Human Immunodeficiency Virus replication. Suppression of viral replication to achieve viral load reduction provides an opportunity for

the immune system to regenerate and increase in quantity. This increase serves as an indicator of reduced risk of opportunistic infections and delayed progression toward AIDS. (Jusriana, Gobel, & Arman, 2020). Negative coping mechanisms among PLHIV tend to result in neglect of treatment schedules. Even occasional non-adherence allows the virus to mutate and develop drug resistance. This resistance not only renders the current ARV regimen ineffective but also directly worsens the immune status of PLHIV by allowing uncontrolled viral replication. Low ARV adherence and poor psychosocial coping form a vicious cycle: poor coping leads to non-adherence, which then results in low immunity, ultimately exacerbating physical and psychological conditions and further weakening coping capacity to remain adherent. ARV adherence, in this context, acts as a bridge between medical intervention and biological outcomes mediated by psychosocial factors. (Irwan, Gani, & Mokodompis, 2025)

The Relationship between Coping Strategies and Immune Status among People Living with HIV (PLHIV)

The findings of this study indicate a significant and strong relationship between coping strategies and immune status among PLHIV at Poncol Public Health Center, Semarang City. The correlation coefficient value of $r = 0.682$ demonstrates a positive relationship with strong correlation strength, reinforced by a significance value of $p < 0.001$, statistically proving that the more adaptive (higher) the coping strategies applied by respondents, the better the immune status, and conversely, the more maladaptive (lower) the coping strategies applied, the poorer the immune status.

This strong association is consistent with psychoneuroimmunology theory, which posits that stress coping mechanisms conditioned by an individual's state have both direct and indirect effects on the immune system (Salami, Muvira, & Yualita, 2021). Clinically, chronic stress and the use of maladaptive coping mechanisms activate the HPA axis, resulting in excessive cortisol production that suppresses cellular immune function, whereas adaptive coping strategies tend to focus on self-management aimed at reducing stress and stabilizing immune responses optimally. (Salami, Muvira, & Yualita, 2021)

In relation to ARV adherence as a strong mediator, coping strategies not only focus on immunity itself but also on respondents' behavior toward the therapy undertaken; although the data show only 31.3%, this still enables PLHIV to respond to and accept their illness by managing stigma, overcoming side effects, and committing to lifelong ARV regimens (Febriani, Lukas, & Murtiani, 2025). This is highly relevant given that the majority of respondents have poor and fair immune status (73.4%) and low to moderate coping strategies (68.8%), indicating the need for strengthened education toward coping mechanisms, particularly among late adulthood age groups (46.9%), to move toward adaptive management.

Coping strategies influence immune status through two pathways: a direct physiological pathway and an indirect behavioral pathway. The direct physiological pathway involves the HPA axis, whereby maladaptive strategies in confronting stress related to HIV/AIDS tend to maintain individuals in a state of chronic stress. This condition can trigger excessive activation of the hypothalamic–pituitary–adrenal (HPA) axis. Prolonged HPA activation causes excessive and sustained cortisol release; high-dose cortisol is known to have immunosuppressive effects that inhibit the proliferation and function of immune cells, thereby directly hindering the recovery and maintenance of immune status, in line with PNI theory. (Salami, Muvira, & Yualita, 2021)

The indirect behavioral pathway involves ARV adherence as a mediator. Adaptive coping strategies (such as problem-solving and seeking support) enable PLHIV to achieve illness acceptance and develop effective self-management. As indicated in the data, adherence to ARV therapy is a strong mediator in this relationship. Adaptive coping provides respondents with the mental capacity to manage stigma, overcome treatment side effects, and maintain lifelong commitment to ARV regimens. Adaptive coping strategies are a behavioral prerequisite for achieving high ARV adherence. Failure in coping (maladaptive coping) leads to non-adherence, which has been clinically proven to increase viral replication and reduce immune system function, thereby indirectly worsening immune status. (Febriani, Lukas, & Murtiani, 2025).

5. Conclusion

Based on the results of the study and the discussion concerning the relationship between adherence to antiretroviral (ARV) therapy and coping strategies with the immune status of people living with HIV (PLHIV), several conclusions can be drawn. The characteristics of the respondents indicate that the majority were in the late adulthood age group (36–45 years), predominantly male, had a senior high school level of education, and were mainly employed in the private sector. The findings obtained at Poncol Public Health Center, Semarang City, show that most PLHIV demonstrated a moderate level of adherence to ARV therapy. In addition, the majority of respondents exhibited coping strategies that fell within the low to moderate categories, while their immune status was predominantly classified as fairly good.

Furthermore, the study confirms a strong relationship between adherence to antiretroviral (ARV) use and respondents' immune status, indicating that higher levels of adherence in consuming ARV are associated with better immune status, reflecting a positive and unidirectional relationship in the context of ARV therapy. The results also demonstrate a strong relationship between coping strategies and immune status, suggesting that effective coping strategies contribute to improvements in immune status and highlight a robust association within the context of coping mechanisms.

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