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Health literacy on HIV/AIDS and adherence to antiretroviral treatment: the moderating role of social support

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ABSTRACT

The increasing prevalence of HIV/AIDS continues to pose a significant global health challenge, with developing countries experiencing the fastest growth in transmission rates, including Indonesia. This quantitative correlational study examined the influence of HIV/AIDS-related health literacy on adherence to antiretroviral (ARV) therapy among people living with HIV/AIDS (PLWHA), with peer social support considered as a moderating variable. Participants included 208 PLWHA residing in Majalengka Regency, West Java, Indonesia. Data were gathered using standardized instruments measuring HIV/AIDS health literacy, treatment adherence, and peer social support, and were analyzed through moderation analysis using Jamovi software. The results demonstrated that HIV/AIDS health literacy had a significant positive effect on ARV adherence, and that peer social support strengthened this relationship. Nonetheless, the study is limited by its cross-sectional design and reliance on self-reported measures, which may restrict causal inference and generalizability.

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1. INTRODUCTION

The rapid spread of HIV/AIDS cases has become one of the most pressing global health challenges. Human immunodeficiency virus (HIV) infection is an epidemic disease that targets the immune system, progressing through stages ranging from primary infection—with or without acute syndrome—to an asymptomatic phase (characterized by the absence of symptoms) and eventually advancing to late-stage infection. Acquired immunodeficiency syndrome (AIDS) represents the final stage of HIV infection. HIV transmission occurs through various routes, including sexual contact, breastfeeding from mother to child, blood transfusions, and the use of contaminated needles [1]-[5]. The highest rates of transmission and disease progression are observed in low-income countries that face educational, economic, and healthcare access barriers, both in terms of availability and quality [6], including in Indonesia, specifically in Majalengka Regency, West Java. Expanding access to antiretroviral therapy (ART) services has had a significant impact on reducing HIV infections and lowering mortality rates among both adults and children worldwide [7].

However, it is concerning that some people living with HIV/AIDS (PLWHA) remain non-adherent to adherence to antiretroviral (ARV) therapy, as evidenced by uncontrolled viral load test results, which are influenced by various factors [8]. Interview findings also revealed that some individuals fail to take ARV medication on time due to forgetfulness and a lack of understanding of the proper usage guidelines. This situation underscores the need for a deeper understanding of the factors affecting ARV treatment adherence.

Adherence to treatment refers to the extent to which an individual follows the medication regimen prescribed by healthcare providers [9]. Adherence encompasses four dimensions: forgetting to take medication, the ability to self-regulate to maintain consistent medication intake, intentional discontinuation of medication, and disruption caused by medication schedules [9]. Understanding these dimensions helps identify the barriers faced by PLWHA in adhering to ARV therapy. High adherence to ARV treatment can improve the health condition of PLWHA, prevent treatment failure, suppress viral replication, reduce the risk of HIV transmission, and protect families from infection [10].

Factors influencing adherence include internal elements such as motivation, perception, health literacy level, awareness, and beliefs [11], [12]. Previous research has indicated a relationship between knowledge and adherence to ARV treatment among PLWHA [13]. Knowledge, which forms the foundation for sustainable behavior, can be enhanced through education [14]-[16]. In this study, HIV/AIDS knowledge is viewed as an outcome of HIV/AIDS health literacy. HIV/AIDS health literacy is a critical factor in optimizing ARV use by promoting adherence to treatment and effective utilization of healthcare services [13]. It encompasses an individual's knowledge, motivation, and ability to access, comprehend, evaluate, and apply health information in making daily decisions about healthcare, disease prevention, and health promotion to maintain or improve quality of life [17]. This health literacy comprises four domains: access, understanding, appraisal, and application [17].

Adherence to ARV therapy among PLWHA is also influenced by social support, which involves actions that help individuals cope with problems through emotional assistance, informational support, instrumental aid, and positive appraisal [18]. Social support includes emotional, appraisal, instrumental, and informational components [19]. It can enhance the motivation and adherence of PLWHA by providing reminders and encouragement from family or friends [20], [21]. Peer social support among PLWHA, as a moderating variable, is expected to reduce the negative impact of low health literacy on ARV adherence. This aligns with previous findings that sharing information within close social networks can mitigate the adverse effects of limited health literacy [22]. Based on these considerations, this study aims to explore the role of peer social support as a moderator strengthening the relationship between HIV/AIDS health literacy and adherence to ARV treatment among PLWHA.

Research on HIV/AIDS health literacy, social support, and ARV adherence has been conducted in various studies over the past five years, employing different methodologies such as qualitative approaches [23]-[25], as well as quantitative methods [26]-[28]. Previous studies have often linked ARV adherence to variables distinct from those examined here, including knowledge, quality of life, motivation, and self-esteem [28]-[30]. While existing literature demonstrates diversity in both approach and variables related to ARV adherence, there remains a scarcity of research investigating HIV/AIDS health literacy with social support as a moderating factor, particularly within the Indonesian context.

Supportive resources within an individual's social network can enhance their ability to access and comprehend medical information, thereby promoting healthier behaviors [22]. Given that social sciences are essential for a comprehensive and holistic understanding of HIV/AIDS [31], this research aims to contribute practical insights into improving ARV adherence among PLWHA, while also enriching health psychology literature through new findings on the interplay between HIV/AIDS health literacy, peer social support, and treatment adherence. The hypotheses of this study are: i) HIV/AIDS health literacy positively influences ARV adherence among PLWHA in Majalengka Regency; and ii) Peer social support positively moderates the relationship between HIV/AIDS health literacy and ARV adherence among PLWHA in Majalengka Regency.

2. METHOD

This research utilizes a quantitative approach with a cross-sectional design. The study population includes PLWHA residing in Majalengka Regency, West Java, Indonesia. Purposive sampling was employed, with the sample meeting the following criteria: having received ART treatment for at least one year, being over the age of 17, and being patients of Hospital "X".

The sample characteristics in this study may introduce selection bias; however, the risk of such bias is considered low. The criterion requiring participants to have undergone antiretroviral (ARV) treatment for at least one year is based on several reasons. Firstly, clinical conditions tend to stabilize after one year of treatment, minimizing interference from physical health issues and early side effects during the data collection process. Secondly, respondents with longer treatment experience are expected to have a better understanding, which can lead to more accurate responses and reduce potential bias associated with the early treatment phase, where adherence measurements often show temporarily elevated levels.

Sampling participants from Hospital "X" is deemed representative of the population since this facility serves as the main referral center for PLWHA in Majalengka Regency. Nevertheless, caution should

be exercised when generalizing the study findings, as the characteristics of respondents in this study may not fully represent PLWHA in other regions with differing social, cultural, and healthcare system contexts.

A total of 208 PLWHA participated in this study. The majority of the respondents were aged 19-40 years, with 67% of them being male (62%). Most of the participants had an education level equivalent to junior high school (35%). Thirty-nine percent of the respondents were married, and the majority were infected with HIV due to male-to-male sexual contact (46.6%).

The research instruments include the Medication Adherence Rating Scale (MARS), a health literacy on HIV/AIDS test, and a social support scale for PLWHA. The MARS consists of 10 questions with a dichotomous response format [9]. The adherence dimensions were designed to detect non-adherence, as self-reports often tend to overstate compliance (faking good), whereas admitting non-adherence is considered a more accurate reflection of actual adherence behavior [32]. The results of the construct validity test with confirmatory factor analysis for the Indonesian version of MARS showed a Chi-square (X^2) value of 12.6, with a significance level (p) of 0.126, CFI of 0.996, TLI of 0.992, and RMSEA of 0.0600. The reliability test results indicated item discrimination indices ranging from 0.420 to 0.917, with an average item discrimination index of 0.794 and a Cronbach's alpha coefficient (α) of 0.915. These results suggest that the Indonesian version of MARS is both valid and reliable in measuring adherence among Indonesians PLWHAs.

The health literacy on HIV/AIDS Test (HLHAT) was developed based on the health literacy domains according to Sørensen, including the ability to access, understand, evaluate, and apply health information [17]. The HLHAT was developed with a dichotomous response format, with options for true or false. The results of the construct validity test with confirmatory factor analysis for the health literacy on HIV/AIDS test show a chi-square (X^2) value of 61.5, a significance level (p) of 0.065, CFI of 0.986, TLI of 0.980, and RMSEA of 0.0459. The reliability is 0.725, with an average item difficulty of 0.511 and an average item discrimination power of 0.657. These results suggest that the HLHAT is both valid and reliable in measuring health literacy on HIV/AIDS among Indonesians PLWHAs.

The social support scale for PLWHA, modified from the social support scale [33], is based on the aspects of social support [19], which include emotional, appraisal, instrumental, and informational support. The construct validity test results with confirmatory factor analysis for the modified social support scale for PLWHA showed a chi-square (X^2) value of 57.9, a significance level (p) of <0.026, CFI of 0.986, TLI of 0.977, and RMSEA of 0.055. The reliability test results indicated item discrimination indices ranging from 0.191 to 0.674, with an average item discrimination index of 0.463 and a Cronbach's alpha coefficient (α) of 0.803. These results suggest that the social support scale is both valid and reliable to measure social support among Indonesian PLWHAs.

The analytical techniques applied in this study include the product-moment correlation test and moderator analysis, with Jamovi version 2.3.28. The Pearson correlation was carried out to determine the relationship between HIV/AIDS health literacy and adherence to ARV treatment. Meanwhile, moderator analysis was conducted to examine the moderating effect of social support from fellow PLWHA on the relationship between health literacy on HIV/AIDS and adherence to ARV treatment.

3. RESULTS AND DISCUSSION

Before conducting moderator analysis, a Pearson correlation test was performed. The Pearson correlation test was used to examine the relationship between two variables: health literacy on HIV/AIDS and adherence to ARV treatment. The correlation between health literacy on HIV/AIDS and adherence to ARV treatment has a Pearson's correlation coefficient (r) of 0.761, with a significance level (p) <0.001. This result indicates that health literacy on HIV/AIDS has a significant positive effect on adherence to ARV treatment. The higher the health literacy on HIV/AIDS among PLWHA, the higher their adherence to ARV treatment. Conversely, the lower the health literacy on HIV/AIDS among PLWHA, the lower their adherence to ARV treatment.

The results of moderator analysis in Table 1 show that health literacy on HIV/AIDS is a significant positive predictor of ARV treatment adherence in PLWHA, with a significance level of <0.001 (moderate estimate p<0.01) with an estimate of 0.103. The significance level of the moderate estimate (p) between the independent variable, health literacy on HIV/AIDS, and the moderator variable, social support among PLWHA, is 0.017 (moderate estimate p<0.05) with an estimate of -0.004. This result indicates that social support among PLWHA significantly moderates the effect of health literacy on HIV/AIDS on ARV treatment adherence.

Table 2 shows the simple slope analysis reveals the role of health literacy on HIV/AIDS as a predictor variable for ARV treatment adherence, at various levels of social support among PLWHA. It can be

seen that at all levels of social support among PLWHA, health literacy on HIV/AIDS has a significant positive role in ARV treatment adherence. Figure 1 illustrates the moderating role of social support on the relationship between health literacy on HIV/AIDS and adherence to ARV treatment. Among PLWHA with low social support from fellow PLWHA, the strength of the role of health literacy on HIV/AIDS in adherence to ARV treatment is higher compared to those who receive moderate or high social support from fellow PLWHA.

Table 1. The results of the moderator analysis

Variable	Estimate	Moderate estimate p
Health literacy on HIV/AIDS	0.103	<0.001
Social support from fellow PLWHA	0.139	<0.001
Health literacy on HIV/AIDS * Social support from fellow PLWHA	-0.004	0.017

Table 2. The results of the simple slope analysis

Level of social support	Estimate	p
Low	0.128	<0.001
Moderate	0.103	<0.001
High	0.079	<0.001

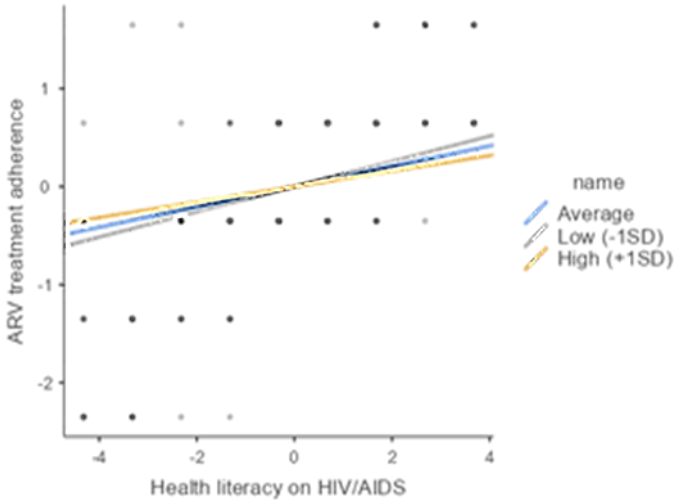

Figure 1. Simple slope plot

The analysis results demonstrate that HIV/AIDS health literacy plays a significantly positive role in ARV therapy. This finding confirms that higher levels of HIV/AIDS health literacy among PLWHA correspond to better adherence to ARV treatment, while lower literacy levels are associated with poorer adherence. Health literacy pertains to an individual's ability to make informed decisions regarding health-related actions [34]. Functional health literacy is defined as the cognitive capacity to comprehend, interpret, and apply both written and verbal health information. Consequently, individuals with adequate literacy skills tend to experience more favorable health outcomes compared to those with limited literacy [13].

Previous research also highlights that enhancing health literacy among PLWHA through online social networks motivates them to engage actively with healthcare providers during consultations, follow medical advice, improve adherence to treatment plans, and reduce anxiety through support group discussions [23]. Health literacy is a critical driver of positive patient outcomes [35]. These findings reinforce the evidence that health literacy can promote adherence to treatment regimens and improve the quality of life for PLWHA.

PLWHA with strong HIV/AIDS health literacy understand the importance of ARV therapy in controlling viral load and recognize the benefits of adherence in prolonging life and enhancing quality of life.

This understanding boosts motivation and self-awareness regarding personal responsibility in health management. The belief that continuing ARV treatment despite side effects correlates positively with adherence [36]. This is consistent with the Health Belief Model (HBM), which posits that beliefs about health behaviors are influenced by various domains, including perceived barriers. Increased understanding impacts attitudes, which in turn influence behavior [37].

This study also found that social support from fellow PLWHA significantly moderates the relationship between HIV/AIDS health literacy and ARV adherence. HIV/AIDS health literacy positively affects ARV adherence across all levels of peer social support, but its influence is strongest among PLWHA receiving low peer support compared to those with moderate or high support. This aligns with findings that social support can modify the strength or direction of the relationship between health literacy and adherence [38]. The effect of health literacy on adherence varies depending on the perceived availability and quality of social support, which encompasses both quantity and quality of social connections [38]. Among PLWHA with low peer support, HIV/AIDS health literacy becomes a critical factor driving adherence. This situation fosters self-reliance in health management, encouraging individuals to follow healthcare instructions and proactively seek information to improve their health literacy. Research shows that 60% of PLWHA with comprehensive knowledge about transmission, care, and treatment receive low social support support [38].

The influence of HIV/AIDS health literacy on adherence is less pronounced among PLWHA with moderate or high peer support. Those receiving sufficient peer support benefit from problem-solving advice, information on HIV/AIDS and ARV treatment, and emotional encouragement. Consequently, the direct effect of health literacy on adherence is diminished because social support itself significantly promotes adherence. Family members, relatives, and friends are often primary consultation sources for health issues, and their support offers protective effects on health behaviors [22]. Practical social support from peers is a strong factor in improving ARV adherence, reducing the direct impact of health literacy on adherence [39].

The availability of social support and resources is especially crucial for individuals with low literacy to facilitate the development of healthy attitudes and behaviors, enhance healthcare access, improve health status, and reduce costly care [22]. However, social support alone does not necessarily increase literacy skills [22]. Instead, social support serves as a buffer against the negative effects of limited health literacy, with its impact more evident among individuals with lower literacy [22].

Low health literacy is associated with poor medication adherence [38], and older adults with limited literacy face higher mortality risks [38]. PLWHA with low health literacy tend to misuse or neglect ARV treatment, adversely affecting their health outcomes [13], [34], [36]. Health literacy involves the skills needed to make informed health-related decisions [34] and is a vital driver of positive patient outcomes [35]. Functional health literacy describes the cognitive capacity to understand, interpret, and apply health information, where higher literacy correlates with better health conditions [13].

These findings highlight the need for targeted interventions for PLWHA with low social support. Clinic- or community-based educational programs can improve HIV/AIDS health literacy and ARV adherence by emphasizing treatment benefits, risks of discontinuation, and proper medication use. Additionally, healthcare providers can implement digital reminder systems or health worker accompaniment to fill gaps in social support. Policymakers and stakeholders should maintain regular education efforts for PLWHA with high social support to enhance health literacy and empower peer support groups for consistent guidance. For PLWHA with low support who are not part of peer groups, the government and NGOs could facilitate the formation of new support groups or provide personalized counseling to tailor strategies according to varying social support levels.

This study has several limitations, including data collection strategies focusing only on hospitals, hotspots, and PLWHA homes, thereby excluding those lost to follow-up. Moreover, numerous factors beyond peer social support, such as support from family, non-PLWHA friends, community, and government, may also influence ARV adherence. Therefore, future research should explore additional factors affecting adherence among PLWHA not addressed in this study and include individuals lost to follow-up. Expanding data collection to diverse settings would also enhance the generalizability of findings.

4. CONCLUSION

The findings indicate that HIV/AIDS health literacy plays a crucial and positive role in promoting ARV therapy. Specifically, PLWHA who possess higher levels of health literacy demonstrate greater adherence to ARV treatment, whereas those with lower health literacy exhibit reduced adherence. Additionally, social support among PLWHA significantly moderates this relationship, with the strongest moderating effect observed among individuals experiencing low social support compared to those with

moderate or high support. The study's limitations include data collection confined to a single location and the exclusion of PLWHA who were lost to follow-up, which suggests caution in generalizing the results. Future studies should consider broadening the scope of data collection across multiple sites, including PLWHA lost to follow-up, and exploring in greater depth how HIV/AIDS health literacy influences treatment adherence in populations with limited social support. Employing qualitative methods or experimental designs to compare the effectiveness of health literacy interventions, peer support, or their combination is also recommended.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The author declares that there is no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [HSW], upon reasonable request.

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