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Loneliness and depressive symptoms among men living with HIV: The mediating role of social support

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Abstract

Loneliness and social support are important psychosocial correlates of depressive symptoms among people living with HIV, but their interrelationships remain insufficiently understood. This cross-sectional study examined associations among loneliness, social support, and depressive symptoms in 436 men living with HIV who acquired infection through sexual transmission. Participants completed an online questionnaire including sociodemographic information, the Patient Health Questionnaire-9, the Social Support Rating Scale, and the UCLA Loneliness Scale. Correlation, multivariable logistic regression, and bootstrap mediation analyses were performed. Loneliness was positively associated with depressive symptoms, whereas social support was inversely associated with loneliness and depressive symptoms. In adjusted logistic regression, high loneliness was associated with greater odds of depressive symptoms, while higher total social support, subjective support, and support utilization were associated with lower odds. Mediation analysis showed that social support partially mediated the association between loneliness and depressive symptoms, accounting for 21.3% of the total effect. These findings suggest that interventions addressing both loneliness and social support may help improve mental health outcomes in this population.

Introduction

Human immunodeficiency virus (HIV) [1] infection remains a major global public health challenge, with more than 40 million people living with HIV worldwide as of 2024 [2]. People living with HIV (PLWH) are at increased risk of mental health problems, with prevalence estimates ranging from 39.0% to 61.0% [3], particularly depressive symptoms [4]. Depressive symptoms are among the most common mental health conditions in this population, with rates significantly higher than those observed in the general population. Recent evidence further indicates that depressive symptoms may adversely affect HIV-related clinical outcomes, including viral suppression and antiretroviral therapy adherence [5].

Among men living with HIV who acquired the infection through sexual transmission, the prevalence of depressive symptoms has been reported to be as high as 47.3% [6]. This elevated risk may be further exacerbated by stigma, discrimination, social isolation, and loneliness [7]. These psychosocial stressors may interact to increase vulnerability to mental health problems in this population.

Loneliness has increasingly been recognized as an important correlate of depressive symptoms [8], yet the mechanisms underlying this relationship remain insufficiently explored in this population. PLWH may be particularly vulnerable to loneliness due to stigma, fear of disclosure, and social marginalization, especially among men infected through sexual transmission.

Social support [9] is another key psychosocial factor that has been shown to be associated with mental health outcomes. Higher levels of social support are generally associated with lower levels of depressive symptoms [7, 10, 11]. Moreover, social support is closely related to loneliness, as individuals with stronger social networks are less likely to experience perceived social isolation [12]. However, evidence suggests that men living with HIV may receive less social support than women [13, 14]. Recent studies

among Chinese PLWH have further suggested that perceived social support is negatively associated with depressive symptoms and may interact with stigma-related mechanisms in shaping mental health outcomes [15, 16].

Previous studies have demonstrated significant associations among loneliness, social support, and depressive symptoms [17, 18]. Although loneliness, social support, and depressive symptoms have each been widely studied, relatively few studies have examined their interrelationships within a unified framework, particularly among men living with HIV who acquired the infection through sexual transmission. Furthermore, the mechanisms linking these factors remain insufficiently understood.

Therefore, this study aimed to examine the associations among loneliness, social support, and depressive symptoms, and to explore whether social support mediates the relationship between loneliness and depressive symptoms in this population.

Methods

Study design and participants

A cross-sectional study was conducted from March to June 2023 at the First Affiliated Hospital of Xiamen University. A total of 436 men living with HIV who acquired the infection through sexual transmission were recruited using convenience sampling. Eligibility criteria included: (a) at least primary school education; (b) confirmed HIV infection for at least one month; (c) clear consciousness and adequate communication ability to cooperate with the instructions and requirements of the study; (d) receipt of highly active antiretroviral therapy (HAART) for at least one month; (e) voluntary participation with informed consent. A total of 680 individuals were initially recruited. After excluding incomplete or invalid responses, 436 valid questionnaires were included in the final analysis, yielding a response rate of 64.1%. The participant selection process is shown in Fig. 1.

A total of 680 individuals living with HIV were initially recruited. After excluding incomplete responses and participants who did not meet the inclusion criteria, 436 men living with HIV who acquired the infection through sexual transmission were included in the final analysis.

Measures

Demographic variables

Data related to the following sociodemographic variables were collected: age, monthly income, housing status, parental health status, marital status, regular exercise habits, smoking status. In addition, we collected data on the most recent $CD4^+$ T-lymphocyte count, $CD8^+$ T-lymphocyte count, and duration of treatment.

Depressive symptoms

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9), which evaluates the severity of depressive symptoms. A score ≥ 10 was used to indicate clinically significant depressive symptoms [19], and the PHQ-9 has demonstrated good reliability [20] and validity among Chinese PLWH. In the present study, Cronbach's α was 0.858.

Social support

Social support was measured using the Social Support Rating Scale (SSRS) [21], which assesses objective support, subjective support, and support utilization. Higher scores indicate greater levels of social support. In this study, Cronbach's α was 0.718.

Loneliness

Loneliness was assessed using the UCLA Loneliness Scale (Version 3), a widely used self-report measure of perceived social isolation [22]. Higher scores indicate greater loneliness, with scores ≥ 44 indicating high loneliness [23]. Previous studies among people living with HIV have also reported high internal consistency for the UCLA Loneliness Scale, with Cronbach's α values exceeding 0.90 [24].

Statistical analysis

Data were analyzed using SPSS version 25.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as medians and interquartile ranges. Group differences were assessed using chi-square tests or Mann–Whitney U tests as appropriate.

Multivariable logistic regression analysis was performed to identify factors associated with depressive symptoms, with results reported as odds ratios (ORs) and 95% confidence intervals (CIs). All tests were two-tailed, and $P < 0.05$ was considered statistically significant.

Pearson correlation analysis was conducted to examine the relationships among loneliness, social support, and depressive symptoms.

Mediation analysis was conducted using Mplus version 8.3. Bootstrapping with 1,000 resamples was used to estimate 95% confidence intervals. A mediation effect was considered statistically significant if the confidence interval did not include zero [25].

This study was approved by the Ethics Committee of Xiamen Xianyue Hospital (Approval No. 3502Z20244ZD1312). Informed consent was obtained from all participants.

Results

Correlation analysis of participant characteristics and depressive symptoms

Baseline characteristics of the participants are presented in Table 1. A total of 436 men living with HIV who acquired the infection through sexual transmission were included. Of these, 189 participants (43.4%) were aged 20 ~ 30 years, 299 (68.6%) reported physically healthy parents, 170 (39.0%) had a monthly income of ¥5,000~<¥8,000, and 256 (58.8%) lived in rented accommodation. Overall, 316 participants (72.5%) were married and 218 (50.0%) reported regular physical activity. Seventy-two participants (16.6%) had $CD4^+$ T-lymphocyte counts < 200 cells/mm^3, and 356 (81.8%) had received antiretroviral therapy for more than two years.

Table 1
Characteristics of participants according to depressive symptom status (n = 436)

Characteristics	Depressive symptoms		χ2/Z	*P* value
	No/mild (n = 280)	Moderate/severe (n = 156)		
Age (years)			3.831	0.147
20 ~ 30	112 (25.7)	77 (17.7)		
31 ~ < 40	107 (24.5)	53 (12.2)		
≥ 40	61 (14.0)	26 (6.0)		
Monthly income (¥)			7.677	0.022
< 5,000	67 (15.4)	54 (12.4)		
5,000 ~ < 8,000	109 (25.0)	61 (14.0)		
≥ 8,000	104 (23.9)	41 (9.4)		
Parental health status			0.048	0.827
Physical health	191 (43.8)	108 (24.8)		
Has physical illness/deceased	89 (20.4)	48 (11.0)		
Housing status			6.803	0.033
Renting	152 (34.9)	104 (23.9)		
Owning a house	97 (22.2)	42 (9.6)		
Others	31 (7.1)	10 (2.3)		
Marital status			5.212	0.074
Unmarried	59 (13.5)	29 (6.6)		
Married	195 (44.7)	121 (27.8)		
Divorce	26 (6.0)	6 (1.4)		
Sports			6.748	0.009
Never exercise	127 (29.1)	91 (20.9)		
Exercise regularly	153 (35.1)	65 (14.9)		
Smoking			10.186	0.006

Note: Data are presented as n (%). Depressive symptoms were categorized according to PHQ-9 scores as no/mild depressive symptoms and moderate/severe depressive symptoms. PHQ-9, Patient Health Questionnaire-9.

Characteristics	Depressive symptoms		χ2/Z	*P* value
	No/mild (n = 280)	Moderate/severe (n = 156)		
None	194 (44.5)	85 (19.5)		
< 1 pack/day	49 (11.2)	36 (8.3)		
> 1 pack/day	37 (8.5)	35 (8.0)		
$CD4^+$ T lymphocytes (cells/mm^3)			7.59	0.006
< 200	36 (8.3)	36 (8.3)		
≥ 200	244 (56.0)	120 (27.5)		
$CD8^+$ T lymphocytes (cells/mm^3)			0.299	0.585
< 967	163 (37.4)	95 (21.8)		
≥ 967	117 (26.8)	61 (14.0)		
Duration of antiretroviral therapy			8.622	0.003
< 2 years	40 (9.2)	40 (9.2)		
≥ 2 years	240 (55.2)	116 (26.6)		

Note: Data are presented as n (%). Depressive symptoms were categorized according to PHQ-9 scores as no/mild depressive symptoms and moderate/severe depressive symptoms. PHQ-9, Patient Health Questionnaire-9.

Correlation and regression analyses of social support, loneliness, and depressive symptoms

Table 2 presents the correlation analysis of social support and depressive symptoms. SSRS scores in this study ranged from 11 to 57. Among participants with moderate to severe depressive symptoms, the median total social support score was 25.02 (20.00, 30.00), with median scores for subjective support of 15.25 (12.00, 18.00), objective support of 4.67 (2.00, 6.00), and support utilization of 5.14 (3.00, 6.00). Rank-sum tests showed that depressive symptoms were negatively associated with total social support and support utilization.

Table 2 also presents the correlation analysis of loneliness and depressive symptoms. Among those with moderate to severe depressive symptoms, 28 had low levels of loneliness, and 128 had high levels of loneliness. A chi-square test was conducted using depressive symptoms as the dependent variable and loneliness level as the independent variable. The results indicated a statistically significant association between depressive symptoms and loneliness.

Table 2
Social support and loneliness according to depressive symptom status

Characteristics		Depressive symptoms		χ^2/Z	*P* value
		No/mild (n = 280)	Moderate/severe (n = 156)		
Social support	Objective support	5.11 (2.00, 7.00)	4.67 (2.00, 6.00)	−1.167	0.243
	Subjective support	16.50 (13.00, 19.00)	15.25 (12.00, 18.00)	−1.937	0.053
	Support utilization	5.54 (5.00, 6.00)	5.14 (3.00, 6.00)	−2.183	0.029
	Total social support score	27.14 (21.00, 32.00)	25.02 (20.00, 30.00)	−2.264	0.024
Loneliness	Low levels of loneliness	125	28	31.342	< 0.001
	High levels of loneliness	155	128		

Note: Data are presented as median and interquartile range or n, as appropriate. Group differences were examined using the Mann–Whitney U test for continuous variables and the chi-square test for categorical variables. SSRS, Social Support Rating Scale.

Table 3

and Fig. 2 show that multivariable logistic regression analysis indicated that higher levels of loneliness were significantly associated with increased odds of depressive symptoms (OR = 3.687, 95% CI: 2.300 ~ 5.910, $P < 0.001$). In contrast, higher levels of social support were associated with reduced odds of depressive symptoms, including total social support (OR = 0.969, 95% CI: 0.945 ~ 0.993, $P = 0.011$), subjective support (OR = 0.954, 95% CI: 0.918 ~ 0.992, $P = 0.018$), and support utilization (OR = 0.882, 95% CI: 0.788 ~ 0.987, $P = 0.028$). The regression results are illustrated in Fig. 2.

Table 3. Multivariable logistic regression analysis of factors associated with depressive symptoms

Variables	Classified	β	Wald	*P* value	OR (95%CI)
Loneliness	Low levels of loneliness				1 (ref)
	High levels of loneliness	1.305	29.361	< 0.001	3.687 (2.300 ~ 5.910)
Total social support score		−0.032	6.4	0.011	0.969 (0.945 ~ 0.993)
Subjective support		−0.047	5.572	0.018	0.954 (0.918 ~ 0.992)
Support utilization		−0.126	4.809	0.028	0.882 (0.788 ~ 0.987)

Note: OR, odds ratio; CI, confidence interval. The reference category for loneliness was low loneliness. The model was adjusted for age, monthly income, housing status, parental health status, marital status, regular physical activity, smoking status, $CD4^+$ T-lymphocyte count, $CD8^+$ T-lymphocyte count, and duration of antiretroviral therapy. Variables with $P < 0.10$ in univariate analysis were included in the multivariable model.

Figure 2. Forest plot of factors associated with depressive symptoms.

Odds ratios (ORs) and 95% confidence intervals (CIs) are presented. An OR > 1 indicates increased odds of depressive symptoms, whereas an OR < 1 indicates decreased odds. The reference category for loneliness was low loneliness.

The mediating roles of social support in the effect of loneliness on depressive symptoms

Table 4 presents the correlation analysis of loneliness, social support, and depressive symptoms in men living with HIV who acquired the infection through sexual transmission. Loneliness was significantly negatively correlated with the utilization of social support (r = − 0.141; $P < 0.01$), indicating that individuals who can make greater use of social support tend to experience lower levels of loneliness. Depressive symptoms were negatively correlated with overall social support, subjective support, and support utilization (r = − 0.172; $P < 0.01$), indicating that individuals who receive more social support are less likely to experience depressive symptoms.

Table 4
Correlations among loneliness, social support, and depressive symptoms

Characteristics	PHQ-9	Loneliness	Objective support	Subjective support	Support utilization	Total social support score
PHQ-9	1.000					
Loneliness	0.137**	1.000				
Objective support	−0.032	−0.081	1.000			
Subjective support	−0.186**	−0.005	0.312**	1.000		
Support utilization	−0.161**	−0.141**	0.364**	0.352**	1.000	
Total social support score	−0.172**	−0.072	0.720**	0.855**	0.603**	1.000

Note: Values are Pearson correlation coefficients. PHQ-9, Patient Health Questionnaire-9; *$P < 0.05$, **$P < 0.01$.

Table 5 presents the results of the mediation analysis examining the mediating role of social support in the association between loneliness and depressive symptoms. In the model, depressive symptoms were specified as the dependent variable, loneliness as the independent variable, and social support as the mediator. The path from loneliness to social support was defined as a, and the path from social support to depressive symptoms was defined as b. The total effect of loneliness on depressive symptoms before the mediator was included was denoted as c, and the direct effect after the mediator was included was denoted as c'. The results remained significant after controlling for covariates. Additional decomposition results are provided in S1 Table.

Table 5
Mediation analysis of social support in the association between loneliness and depressive symptoms

Dependent variable	Independent variable	R^2	b	S.E.	*z*	*P* value	LLCI	ULCI
Before adjustment								
Social support	Loneliness	0.060	−0.023	0.010	−2.199	0.028	−0.046	−0.005
Depressive symptoms	Social support	0.021	−0.596	0.241	−2.476	0.013	−1.186	−0.213
	Loneliness		0.049	0.021	2.362	0.018	0.004	0.086
After adjustment								
Social support	Loneliness	0.068	−0.023	0.01	−2.202	0.028	−0.046	−0.005
Depressive symptoms	Social support	0.021	−0.589	0.245	−2.408	0.016	−1.186	−0.199
	Loneliness		0.048	0.021	2.312	0.021	0.004	0.085

Note: b, unstandardized regression coefficient; SE, standard error; CI, confidence interval; LLCI, lower limit of the confidence interval; ULCI, upper limit of the confidence interval. Mediation analysis was conducted using bootstrapping with 1,000 resamples. The mediation effect was considered statistically significant when the 95% CI did not include zero. Models were adjusted for relevant covariates. *$P < 0.05$.

With Mplus, the bootstrap method with 1,000 resamples and a 95% confidence interval was applied. Mediation analysis indicated that social support partially mediated the association between loneliness and depressive symptoms. The indirect effect was statistically significant (95% CI: 0.003 ~ 0.037), accounting for 21.3% of the total effect. After controlling for social support, the direct effect of loneliness on depressive symptoms remained significant, suggesting a partial mediation effect. The mediation model is presented in Fig. 3.

Note

Standardized path coefficients (β) with 95% confidence intervals (CI) are presented.

Adjusted for: age, monthly income, housing status, parental health status, marital status, physical activity, smoking status, CD4 + T-cell count, CD8 + T-cell count, and duration of antiretroviral therapy.

Discussion

The present study demonstrates that loneliness, social support, and depressive symptoms are closely interconnected within a broader psychosocial framework. Notably, social support partially mediated the

relationship between loneliness and depressive symptoms, highlighting a potential pathway through which loneliness may influence mental health outcomes.

Consistent with previous studies, depressive symptoms were highly prevalent among PLWH [26, 27]. In the present study, the prevalence of depressive symptoms was 35.9%, further underscoring the substantial mental health burden in this population. While prior research has identified loneliness and social support as important correlates, the present findings extend the literature by clarifying their interrelationships within a unified analytical framework.

The positive association between loneliness and depressive symptoms is consistent with existing evidence [7, 24, 28]. Loneliness, as a subjective experience of social disconnection, may contribute to emotional distress and increase vulnerability to depression [29]. PLWH often face stigma, discrimination, and social marginalization, which may reduce social engagement [30] and increase feelings of loneliness [31]. These psychosocial stressors may heighten vulnerability to depressive symptoms.

In contrast, social support was inversely associated with both loneliness and depressive symptoms, which aligns with previous findings [32–34]. Individuals with higher levels of social support may have greater access to emotional, informational, and instrumental resources, thereby facilitating coping and reducing psychological distress [35]. The observed negative association between social support and loneliness further suggests that supportive social relationships may alleviate perceived social isolation [36]. These findings are consistent with the stress-buffering hypothesis, which posits that social support can mitigate the adverse psychological effects of stressors.

Importantly, the mediation analysis indicated that social support partially mediated the association between loneliness and depressive symptoms. This suggests that loneliness may be associated with depressive symptoms both directly and indirectly through reduced social support. One possible explanation is that individuals experiencing higher levels of loneliness may be less likely to perceive, seek, or effectively utilize available support resources, which may increase their susceptibility to depressive symptoms. Similar mediating mechanisms have been reported in previous studies [10, 11], supporting the notion that social support functions as a key linking factor between psychosocial stressors and mental health outcomes. This interpretation is also supported by recent evidence among newly diagnosed HIV-positive men who have sex with men, showing that social support may mediate the association between stigma-related stressors and mental health [37].

In addition, the relationships among loneliness, social support, and depressive symptoms are likely to be dynamic and potentially reciprocal. Reduced social support may increase the likelihood of depressive symptoms [34, 35], while depressive symptoms may impair individuals' motivation and capacity to maintain or mobilize social relationships, resulting in further reductions in perceived support [38, 39]. Similarly, loneliness may both result from and contribute to social withdrawal. This bidirectional relationship highlights the complexity of psychosocial mechanisms underlying depressive symptoms in people living with HIV [40, 41].

Taken together, these findings support a conceptual framework in which loneliness, social support, and depressive symptoms are interconnected within a broader psychosocial system. Rather than acting as isolated factors, these variables may influence one another through both direct and indirect pathways. Understanding these interrelationships may provide a more comprehensive perspective on the development and maintenance of depressive symptoms in this population.

From a clinical and public health perspective, these findings have important implications. Interventions aimed at reducing depressive symptoms among men living with HIV should not focus solely on individual-level emotional symptoms but should also address interpersonal and social contexts. Strategies such as peer support programs, community-based services, and stigma reduction initiatives may help strengthen social support networks and reduce loneliness [42, 43]. In addition, individuals with both high loneliness and low social support may represent a particularly vulnerable subgroup and should be prioritized for targeted interventions.

Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference, and the findings should be interpreted as associations rather than causal relationships. Second, all variables were assessed using self-reported measures, which may introduce reporting bias. Third, the study was conducted in a single region, which may limit the generalizability of the findings. Finally, residual confounding cannot be excluded. Future longitudinal and intervention studies are needed to clarify the temporal ordering and potentially reciprocal relationships among loneliness, social support, and depressive symptoms, as recent longitudinal evidence suggests that perceived social support and stigma-related factors may influence depressive symptoms over time among PLWH [44].

Conclusion

Loneliness was positively associated with depressive symptoms among men living with HIV who acquired the infection through sexual transmission, whereas social support was inversely associated with depressive symptoms. Social support partially mediated the association between loneliness and depressive symptoms. These findings highlight the potential importance of addressing both loneliness and social support to improve mental health outcomes in this population. Further longitudinal research is needed to clarify the underlying mechanisms.

Abbreviations

HIV	Human immunodeficiency virus
AIDS	Acquired immunodeficiency syndrome
PHQ-9	Patient Health Questionnaire-9
SSRS	Social Support Rating Scale
UCLA	University of California, Los Angeles
CI	Confidence interval
OR	Odds ratio
SD	Standard deviation

Declarations

Ethics approval and consent to participate

This research was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee of Xiamen Xianyue Hospital (Approval No. 3502Z20244ZD1312). Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Data availability

Due to privacy constraints, the datasets generated and analyzed in this study are not publicly available but are available from the corresponding author on reasonable request.

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Authors' contributions

RC, JQ, and YZ contributed to the methodology, data curation, and drafting of the original manuscript. CZ and YL were responsible for study design, conceptualization, and critical revision of the manuscript. JZ, WW, and YH partially participated in the research design. All authors have read and approved the final version of the manuscript and agreed with the order of authorship.

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Figures

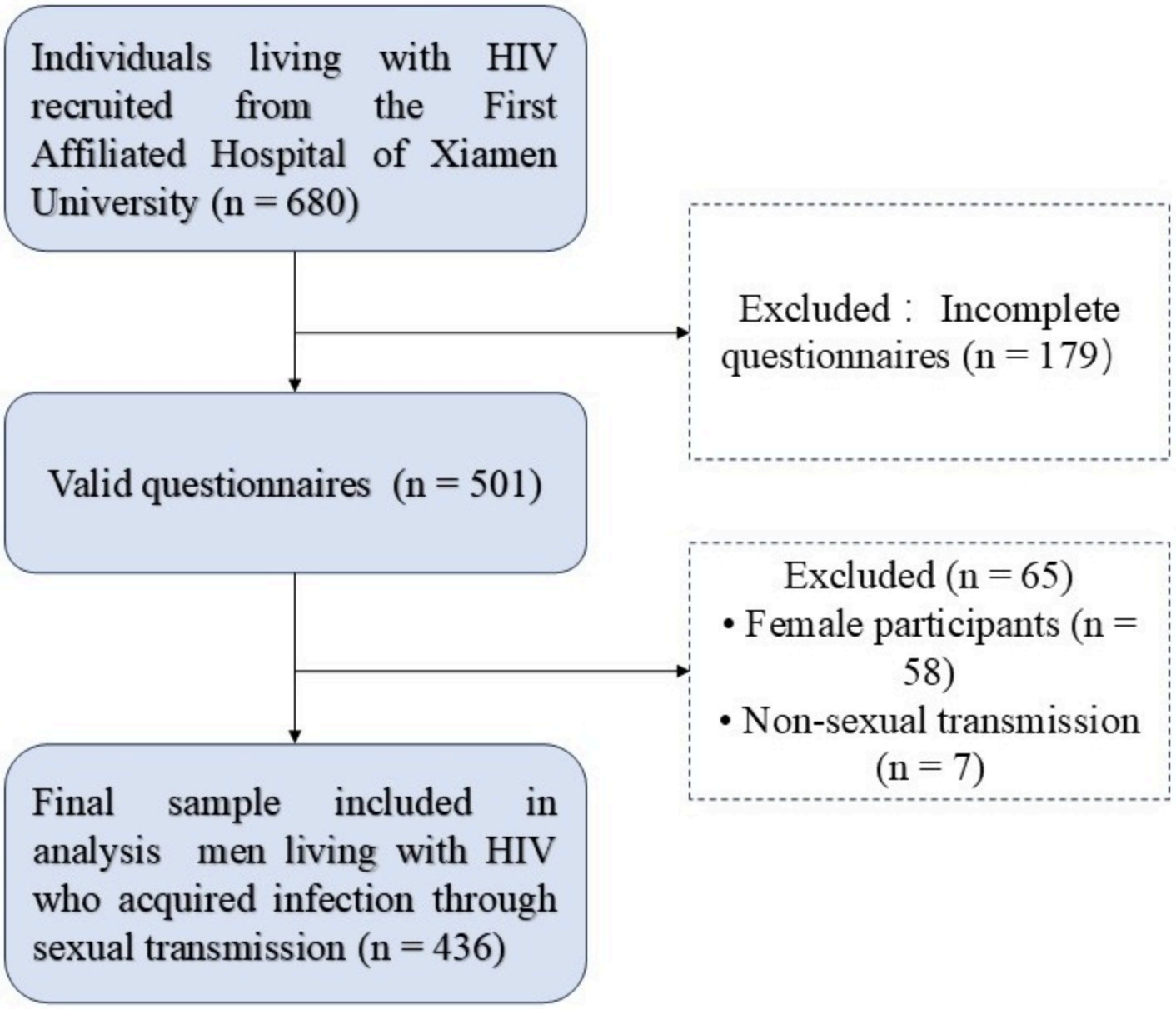

Figure 1

Flowchart of participant selection.

A total of 680 individuals living with HIV were initially recruited. After excluding incomplete responses and participants who did not meet the inclusion criteria, 436 men living with HIV who acquired the infection through sexual transmission were included in the final analysis.

Variables	Adjusted OR (95% CI)	p value
Loneliness		
High vs low	3.687 (2.300–5.910)	0.001
Social support		
Total social support score	0.969 (0.945–0.993)	0.011
Subjective support	0.954 (0.918–0.992)	0.018
Support utilization	0.882 (0.788–0.987)	0.028

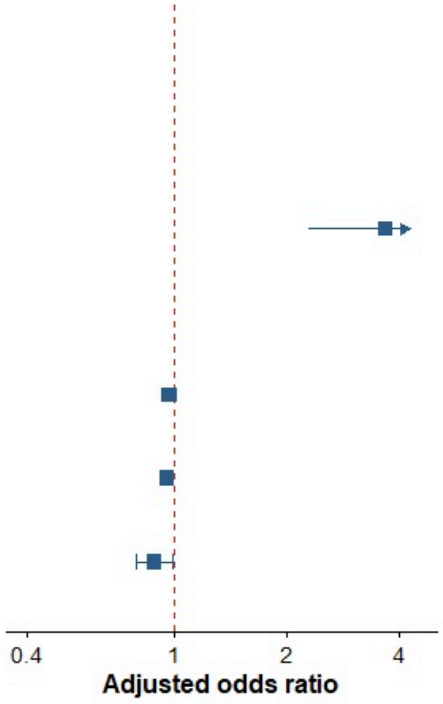

Figure 2

Forest plot of factors associated with depressive symptoms.

Odds ratios (ORs) and 95% confidence intervals (CIs) are presented. An OR >1 indicates increased odds of depressive symptoms, whereas an OR <1 indicates decreased odds. The reference category for loneliness was low loneliness.

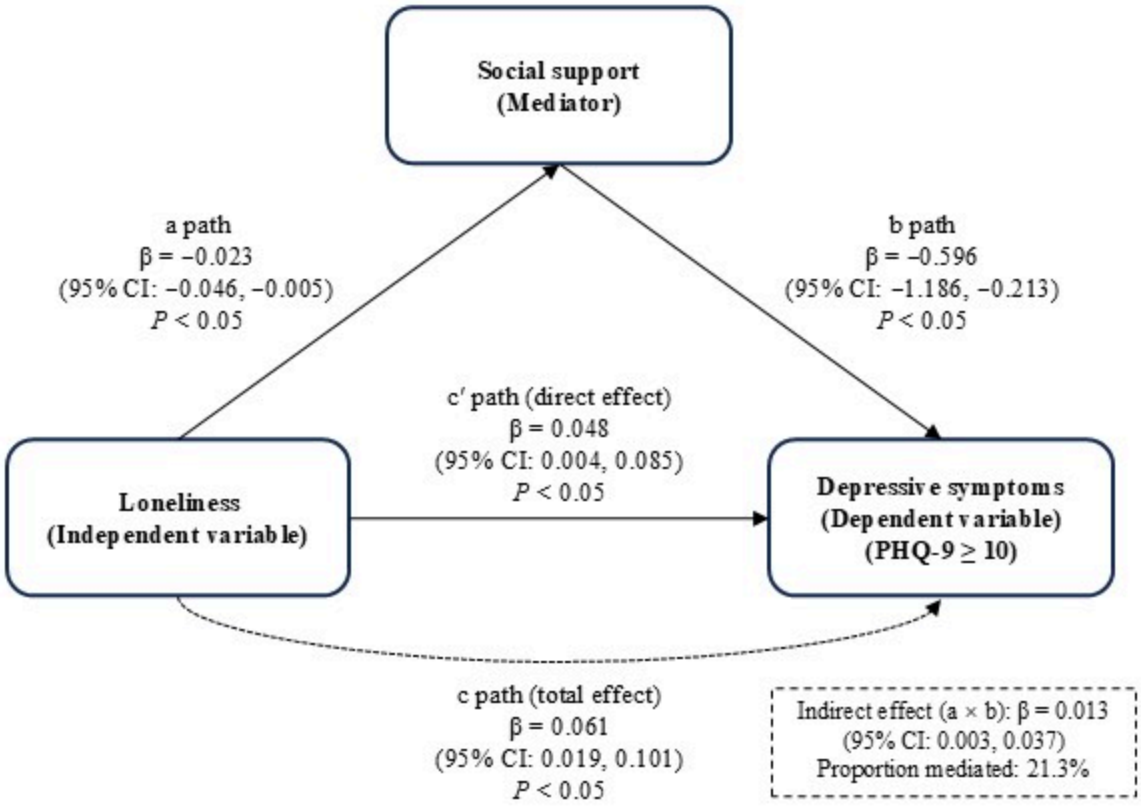

Figure 3

Mediation model of loneliness, social support, and depressive symptoms.

Note: Standardized path coefficients (β) with 95% confidence intervals (CI) are presented.

Adjusted for: age, monthly income, housing status, parental health status, marital status, physical activity, smoking status, CD4+ T-cell count, CD8+ T-cell count, and duration of antiretroviral therapy.

Supplementary Files

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- S1Table.docx