Research Square

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Burden and Risk Factors of HBV, HCV, Syphilis, and HIV Infections Among Homeless Patients With Severe Mental Illness: A Retrospective Comparative Study in Southern China

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Research Article

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Abstract

Background

Homeless individuals with severe mental illness are a medically underserved population with increased vulnerability to blood-borne and sexually transmitted infections. However, evidence regarding the combined burden of hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis, and human immunodeficiency virus (HIV) infection in this population remains limited in China.

Objective

This study aimed to compare the prevalence of HBV, HCV, syphilis, and HIV infections between homeless and non-homeless psychiatric inpatients and to identify infection-related risk factors among homeless patients with severe mental illness.

Methods

This retrospective comparative study included 235 homeless patients with severe mental illness admitted to Hainan Provincial Anning Hospital between January 2020 and January 2024 and 235 age- and sex-matched non-homeless psychiatric inpatients admitted during the same period. Serological testing was performed for hepatitis B surface antigen, anti-HCV antibody, anti-Treponema pallidum antibody, and anti-HIV antibody. $CD4^+$ T-cell counts, nutritional status, homelessness duration, history of intravenous drug use, sexual risk behavior, and psychiatric treatment adherence were assessed. Multivariable logistic regression was used to identify independent risk factors for infection with at least one of the four pathogens.

Results

The prevalence of HBV, HCV, syphilis, and HIV infection was significantly higher in homeless patients than in non-homeless controls: 12.34% vs. 7.66% for HBV, 11.06% vs. 3.83% for HCV, 7.23% vs. 2.13% for syphilis, and 2.98% vs. 0.85% for HIV, respectively. Homeless patients also had significantly lower $CD4^+$ T-cell counts than controls (312 ± 89 vs. 498 ± 102 cells/μL, $P < 0.001$) and higher proportions of malnutrition and high-risk behaviors. Among homeless patients, homelessness duration > 3 years, intravenous drug use, and poor adherence to psychiatric treatment were independently associated with infection, with odds ratios of 3.63, 5.74, and 2.83, respectively.

Conclusions

Homeless patients with severe mental illness had a substantially higher burden of HBV, HCV, syphilis, and HIV infections than non-homeless psychiatric inpatients. Prolonged homelessness, intravenous drug use, and poor psychiatric treatment adherence were key independent risk factors. These findings support the need for integrated screening, psychiatric stabilization, harm reduction, and infectious disease management in this vulnerable population.

Introduction

Homeless individuals with severe mental illness represent a highly marginalized and medically underserved population. Owing to unstable living conditions, limited access to regular healthcare, poor hygiene, and impaired self-care capacity, this group is particularly vulnerable to infectious diseases[1–4]. Blood-borne and sexually transmitted infections, including hepatitis B virus (HBV), hepatitis C virus (HCV), syphilis, and human immunodeficiency virus (HIV), are of particular concern because they may remain undiagnosed for long periods and contribute to both individual disease progression and community-level transmission[5, 6].

Severe mental illness may further increase infectious disease risk through several interconnected pathways. Psychiatric symptoms, cognitive impairment, poor insight, and social disorganization can reduce treatment adherence and limit engagement with preventive healthcare services. In addition, homelessness is often accompanied by malnutrition, high-risk sexual behavior, substance use, and delayed medical intervention. These overlapping vulnerabilities may create a syndemic pattern in which psychiatric instability, behavioral risk, immune dysfunction, and infectious disease reinforce one another[7–9].

Although previous studies have reported increased rates of infectious diseases among homeless populations or psychiatric patients, evidence focusing specifically on homeless individuals with severe mental illness remains limited, particularly in China. Existing domestic studies have often been restricted by small sample sizes, single-pathogen screening, or insufficient assessment of behavioral and clinical risk factors. As a result, the combined burden of HBV, HCV, syphilis, and HIV infection in homeless psychiatric patients, as well as the factors associated with infection, remains inadequately characterized[10–12].

To address this gap, we conducted a retrospective comparative study of homeless patients with severe mental illness and age- and sex-matched non-homeless psychiatric inpatients admitted in southern China from 2020 to 2024. We compared the prevalence of HBV, HCV, syphilis, and HIV infection between the two groups and evaluated $CD4^+$ T-cell counts, nutritional status, high-risk behaviors, homelessness duration, and psychiatric treatment adherence. We further used multivariable logistic regression to identify independent risk factors for infection among homeless patients. The findings may provide evidence for integrated psychiatric and infectious disease screening, risk stratification, and public health intervention in this vulnerable population.

Methods

Study Design and Participants

This retrospective comparative study was conducted at Hainan Provincial Anning Hospital, China. We reviewed the medical records of homeless patients with severe mental illness who were admitted between January 2020 and January 2024. During the same period, non-homeless psychiatric inpatients were selected as the control group.

The homeless group included 235 patients with severe mental illness who had no fixed residence, lacked stable social support, or were identified as homeless at admission. The control group included 235 age- and sex-matched psychiatric inpatients with stable residence and no history of homelessness. All participants were diagnosed with schizophrenia or bipolar disorder according to the International Classification of Diseases, 10th Revision (ICD-10), or the Chinese Classification of Mental Disorders, Third Edition (CCMD-3). The original dataset included 235 homeless patients and 235 non-homeless psychiatric inpatients admitted during the same study period.

Ethical Approval

and Informed Consent

The study protocol was approved by the Ethics Committee of Hainan Provincial Anning Hospital. Written informed consent was obtained from each participant's legal guardian or appointed temporary custodian. All personal information was anonymized before analysis, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows:Aged 18 years or older;Diagnosed with schizophrenia or bipolar disorder according to ICD-10 or CCMD-3;Able to undergo venous blood collection and structured behavioral interview[13];For the homeless group: no fixed residence, no valid identity documents, and recent living in public places or shelters.Exclusion criteria included:History of confirmed HBV, HCV, syphilis, or HIV infection prior to admission;Severe physical comorbidities (e.g., hepatic failure, renal insufficiency, malignancy);Recent (within 1 month) antiviral or immunosuppressive therapy;Incomplete clinical records or poor-quality samples;Acute intoxication or cognitive impairment preventing assessment.

Laboratory Testing

Peripheral venous blood samples were collected from all participants at admission. Serum samples were tested for hepatitis B surface antigen (HBsAg), anti-HCV antibody, anti-Treponema pallidum

antibody, and anti-HIV-1/2 antibody using enzyme-linked immunosorbent assay kits. HIV-reactive samples were sent to the local Center for Disease Control and Prevention for confirmatory testing.

For seropositive individuals, additional virological or serological assessments were performed when available, including HBV DNA, HCV RNA, and TPHA titers. $CD4^+$ T-cell counts were measured by flow cytometry and expressed as cells/μL. The English draft specifies the use of ELISA screening, confirmatory testing for HIV-reactive samples, quantitative nucleic acid testing for HBV/HCV-positive samples, and flow cytometry for $CD4^+$ T-cell counts.

Behavioral and Nutritional Assessment

Clinical and behavioral information was collected from medical records and structured interviews conducted by trained psychiatric staff. The variables included duration of homelessness, history of intravenous drug use, history of unprotected sexual behavior, psychiatric treatment adherence, and nutritional status.

Duration of homelessness was categorized as ≤ 3 years or > 3 years. Intravenous drug use was defined as any previous or current history of injecting illicit drugs. Poor psychiatric treatment adherence was defined as irregular use or discontinuation of antipsychotic medication within the previous six months. Nutritional status was assessed using body mass index (BMI), and malnutrition was defined as BMI < 18.5 kg/m^2 according to World Health Organization criteria.

Statistical Analysis

All data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on data distribution. Between-group comparisons were performed using the independent-samples t test for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables.

Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher’s exact test, as appropriate. Correlation analysis was used to evaluate the association between behavioral factors and HIV/HCV infection among homeless patients. Multivariable logistic regression was performed to identify independent risk factors for infection with at least one pathogen. Variables with clinical relevance or $P < 0.10$ in univariable analysis were entered into the multivariable model. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. A two-sided P value < 0.05 was considered statistically significant. The original draft used SPSS 26.0, chi-square tests, independent-samples t tests, and logistic regression for risk-factor analysis.

Results

Baseline characteristics of the study population

A total of 470 psychiatric inpatients were included in this study, comprising 235 homeless patients with severe mental illness and 235 non-homeless psychiatric inpatients as controls. All participants completed serological testing for HBV, HCV, syphilis, and HIV. The two groups were comparable in age and sex distribution according to the study design. The homeless group was characterized by unstable residence, limited social support, and a higher burden of behavioral and nutritional risk factors.

Prevalence of HBV, HCV, syphilis, and HIV infections

The prevalence of all four infectious diseases was higher in homeless patients than in non-homeless controls (Table 1). In the homeless group, the prevalence rates of HBV, HCV, syphilis, and HIV were 12.34%，11.06%，7.23%，and 2.98%, respectively. In comparison, the corresponding prevalence rates in the control group were 7.66%，3.83%，2.13%，and 0.85%, respectively. The between-group differences were statistically significant for HBV, HCV, syphilis, and HIV infection, indicating a substantially greater infectious disease burden among homeless patients with severe mental illness. The same infection-rate data are shown in the original results table.

Table 1
Prevalence of HBV, HCV, Syphilis, and HIV Infections in Homeless and Non-Homeless Psychiatric Patients

Infection Type	Homeless Group (n = 235)	Control Group (n = 235)	χ^2 Value	P Value
HBV (HBsAg-positive)	29(12.34%)	18(7.66%)	5.739	0.037
HCV (anti-HCV-positive)	26(11.06%)	9(3.83%)	8.134	0.008
Syphilis (anti-Treponema pallidum-positive)	17(7.23%)	5(2.13%)	5.432	0.012
HIV (anti-HIV-positive)	7(2.98%)	2(0.85%)	4.651	0.014
Note: HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; HBsAg, hepatitis B surface antigen. P values were calculated using the chi-square test.				

$CD4^+$T Cell Counts and Viral Load Distribution

As shown in Fig. 1, homeless patients had significantly lower $CD4^+$ T-cell counts than non-homeless controls. The mean $CD4^+$ T-cell count was 312 ± 89 cells/μL in the homeless group and 498 ± 102 cells/μL in the control group, with a statistically significant difference between groups ($t = 5.672$, $P < 0.001$). This finding suggests that homeless patients with severe mental illness may have poorer immune status than non-homeless psychiatric inpatients.

Viral load distribution among infected individuals is shown in Fig. 2. A subset of homeless patients had elevated viral replication levels, particularly among those with HBV or HCV infection. These findings

suggest that infections in the homeless group were not only more frequent but also more likely to be virologically active.

Viral load and antibody titer levels among infected individuals

Among seropositive individuals, homeless patients showed higher levels of viral replication or antibody titers than controls (Table 2). Among HBV-infected individuals, 62.07% of homeless patients had HBV DNA levels ≥ 10^4 IU/mL, compared with 33.33% of controls (P = 0.034). Among HCV-infected individuals, HCV RNA positivity was observed in 70.00% of homeless patients and 33.33% of controls (P = 0.032). Similarly, among patients with syphilis, TPHA titers ≥ 1:80 were more frequent in the homeless group than in the control group, at 73.33% and 25.00%, respectively (P = 0.041).

Table 2
Viral Load and Antibody Titer Levels Among Seropositive Individuals

Indicator	Homeless Group (n = 235)	Control Group (n = 235)	Statistical test	P Value
HBV DNA ≥ 10^4 IU/mL among HBsAg-positive patients	18/29(62.07%)	5/15(33.33%)	χ^2=5.157	0.034
HCV RNA positivity among anti-HCV-positive patients	14/20(70.00%)	2/6(33.33%)	Fisher's exact test	0.032
TPHA titer ≥ 1:80 among syphilis-positive patients	11/15(73.33%)	1/4(25.00%)	χ^2=3.853	0.041

Note: Analyses were performed among seropositive individuals with available confirmatory viral load or antibody titer data. HBV, hepatitis B virus; HCV, hepatitis C virus; HBsAg, hepatitis B surface antigen; TPHA, Treponema pallidum hemagglutination assay.

These results indicate that homeless patients with severe mental illness may carry a higher burden of active or clinically significant infection.

Nutritional Status and High-Risk Behaviors

The homeless group had a significantly higher rate of malnutrition than the control group (Fig. 3). Malnutrition, defined as BMI < 18.5 kg/m², was present in 97 of 235 homeless patients, accounting for 41.28% of the group. In contrast, 44 of 235 non-homeless controls were malnourished, accounting for 18.72% of the control group (P < 0.001).

High-risk behaviors were also significantly more common in homeless patients. A total of 121 homeless patients, accounting for 51.49%, reported high-risk sexual behavior or needle sharing, compared with 59 controls, accounting for 25.11% (P < 0.001). These results suggest that the homeless group had a greater combined burden of nutritional vulnerability and behavioral exposure to infection.

Behavioral factors associated with HIV/HCV infection

Among homeless patients, behavioral risk factors were significantly associated with HIV/HCV infection (Table 3). A history of unprotected sexual behavior was reported in 145 patients, accounting for 61.70% of the homeless group, and was positively correlated with HIV/HCV infection (r = 0.42, P = 0.001). Intravenous drug use was reported in 55 patients, accounting for 23.40%, and showed the strongest correlation with HIV/HCV infection (r = 0.57, P = 0.002). Poor adherence to psychiatric treatment was observed in 199 patients, accounting for 84.68%, and was also significantly associated with HIV/HCV infection (r = 0.39, P = 0.005).

Table 3
Behavioral Risk Factors and Their Correlations With HIV/HCV Infection Among Homeless Patients

Behavioral Factor	**Frequency ,n(%)**	**Correlation Coefficient (r)**	***P Value***
Unprotected sexual behavior	145(61.70%)	0.42	0.001
Intravenous drug use	55(23.40%)	0.57	0.002
Poor adherence to psychiatric treatment	199(84.68%)	0.39	0.005
Note: Correlation analysis was performed among homeless patients with severe mental illness. HIV, human immunodeficiency virus; HCV, hepatitis C virus.			

These findings indicate that behavioral instability and treatment discontinuity may contribute to the elevated risk of blood-borne infection in homeless patients with severe mental illness.

Multivariate Logistic Regression Analysis

Multivariable logistic regression was performed to identify independent risk factors for infection with at least one of the four pathogens among homeless patients (Table 4). Homelessness duration > 3 years was independently associated with infection, with an odds ratio of 3.63 and a 95% confidence interval of 1.63–6.34 (P = 0.001). A history of intravenous drug use was also an independent risk factor, with an odds ratio of 5.74 and a 95% confidence interval of 2.31–12.32 (P = 0.001). Poor adherence to psychiatric treatment remained independently associated with infection, with an odds ratio of 2.83 and a 95% confidence interval of 1.42–5.54 (P = 0.003).

Table 4
Multivariable Logistic Regression Analysis of Risk Factors for Infection Among Homeless Patients

Variable	β	Odds Ratio (OR)	95% CI	*P Value*
Homelessness duration > 3 years	1.14	3.63	1.63–6.34	0.001
Intravenous drug use	1.66	5.74	2.31–12.32	0.001
Poor adherence to psychiatric treatment	1.01	2.83	1.42–5.54	0.003
Malnutrition (BMI < 18.5 kg/m²)	0.47	1.75	0.79–2.94	0.121
Disordered sexual behavior	0.54	1.87	0.93–3.78	0.072

Note: The dependent variable was infection with at least one of the four pathogens, including HBV, HCV, syphilis, or HIV. OR, odds ratio; CI, confidence interval. The reference group was patients without the corresponding exposure.

Although malnutrition and high-risk sexual behavior were more frequent among infected patients, they did not reach statistical significance in the multivariable model. These results suggest that prolonged homelessness, intravenous drug use, and poor psychiatric treatment adherence are the major independent predictors of infectious disease burden in this population.

Discussion

In this retrospective comparative study, we found that homeless patients with severe mental illness had a significantly higher burden of HBV, HCV, syphilis, and HIV infections than non-homeless psychiatric inpatients. In addition to higher infection rates, the homeless group showed lower $CD4^+$ T-cell counts, higher proportions of active viral replication or elevated antibody titers among infected individuals, and greater exposure to malnutrition and high-risk behaviors[14–16].Multivariable logistic regression further identified homelessness duration > 3 years, intravenous drug use, and poor adherence to psychiatric treatment as independent risk factors for infection. These findings suggest that infectious disease vulnerability in homeless psychiatric patients is driven not by a single exposure, but by the combined effects of prolonged social instability, behavioral risk, impaired healthcare access, and poor continuity of psychiatric care[17, 18].

The higher prevalence of blood-borne and sexually transmitted infections in the homeless group is clinically and epidemiologically important. Homeless individuals with severe mental illness often live in unstable or unsanitary environments and may have limited access to preventive services, regular screening, vaccination, and timely treatment. Psychiatric symptoms, impaired judgment, cognitive dysfunction, and poor insight may further reduce their ability to avoid high-risk exposures or seek medical care[19, 20]. In the present study, the homeless group had higher rates of unprotected sexual behavior, intravenous drug use, and poor psychiatric treatment adherence, all of which may increase the risk of HBV, HCV, syphilis, and HIV transmission. Among these factors, intravenous drug use showed the

strongest association with HIV/HCV infection, supporting its central role in blood-borne pathogen transmission in this population[21, 22].

Another important finding was the significantly lower $CD4^+$ T-cell count observed in homeless patients. Although $CD4^+$ T-cell depletion is most commonly discussed in the context of HIV infection, reduced $CD4^+$ T-cell counts in this population may also reflect broader immune vulnerability associated with malnutrition, chronic stress, untreated infection, and inadequate medical care. The homeless group also had a markedly higher rate of malnutrition than controls, which may further impair host immune defense and increase susceptibility to infection. Together, these findings support a “behavior–nutrition–immunity–infection” interaction model, in which unstable living conditions and behavioral risks increase pathogen exposure, while malnutrition and immune dysfunction may worsen infection susceptibility and disease activity.

The finding that homeless patients had higher proportions of HBV DNA elevation, HCV RNA positivity, and high TPHA titers among seropositive individuals further suggests that infection in this group may be more clinically active or transmissible. This has important implications for public health management. Patients with active viral replication may serve as a source of ongoing transmission if they remain undiagnosed or untreated, particularly in shelters, temporary care facilities, psychiatric wards, or community environments where infection-control resources may be limited. Therefore, screening alone is insufficient; positive cases require timely confirmatory testing, linkage to antiviral or antimicrobial treatment, follow-up monitoring, and coordinated management between psychiatric and infectious disease services.

Our findings are consistent with previous studies showing that homelessness, severe mental illness, substance use, and poor access to healthcare are associated with increased infectious disease risk. However, the present study adds several clinically relevant observations. First, we evaluated four major infectious diseases simultaneously rather than focusing on a single pathogen. Second, we included a non-homeless psychiatric inpatient control group, which allowed us to distinguish the additional risk associated with homelessness among patients with psychiatric illness. Third, we combined serological screening, immune-status assessment, behavioral variables, and regression analysis, providing a more comprehensive picture of infection vulnerability in this population. These features strengthen the relevance of our results for psychiatric hospitals, public health departments, and social assistance systems.

The independent association between poor psychiatric treatment adherence and infection is particularly noteworthy. Poor adherence may be both a marker and a mediator of social and clinical instability. Patients who discontinue antipsychotic treatment may experience worsening symptoms, impaired self-care, disorganized behavior, and reduced ability to avoid infection-related risks. Conversely, infection, malnutrition, and homelessness may further destabilize psychiatric illness and reduce treatment engagement. This bidirectional relationship highlights the need to view infectious disease prevention and psychiatric stabilization as interconnected goals rather than separate tasks. In clinical practice,

infectious disease screening should be incorporated into routine admission assessments for homeless psychiatric patients, while psychiatric follow-up should be integrated into infection-control and community reintegration programs.

From a public health perspective, the results support the development of an integrated care model for homeless patients with severe mental illness. Such a model should include routine screening for HBV, HCV, syphilis, and HIV at admission; HBV vaccination for susceptible individuals; confirmatory testing and treatment linkage for positive cases; harm-reduction interventions for patients with injection drug use; sexual health education and condom provision; nutritional assessment and support; and structured psychiatric follow-up to improve treatment continuity. Collaboration among psychiatric hospitals, infectious disease specialists, Centers for Disease Control and Prevention, community health services, and social welfare agencies is essential to reduce both individual disease burden and community transmission risk.

This study has several limitations. First, it was conducted in a single psychiatric hospital in southern China, which may limit the generalizability of the findings to other regions or healthcare settings. Second, the retrospective design limits causal inference, and some behavioral variables may be affected by recall bias or incomplete documentation. Third, although the study assessed multiple pathogens and several behavioral risk factors, it did not evaluate long-term outcomes after diagnosis, such as treatment initiation, viral suppression, cure of HCV, syphilis treatment response, psychiatric relapse, or social reintegration. Fourth, some potentially important variables, including vaccination history, detailed sexual network information, duration and severity of psychiatric illness, substance-use patterns, and socioeconomic indicators, were not fully available.

Future studies should include multicenter prospective cohorts with standardized behavioral assessments, detailed infection histories, and longitudinal follow-up. It would also be valuable to evaluate whether integrated psychiatric–infectious disease interventions can improve screening uptake, treatment completion, viral suppression, psychiatric stability, and social reintegration. In addition, qualitative studies exploring barriers to healthcare access among homeless patients with severe mental illness may help design more acceptable and sustainable intervention programs.

Conclusion

Homeless patients with severe mental illness had a significantly higher burden of HBV, HCV, syphilis, and HIV infections than non-homeless psychiatric inpatients. Prolonged homelessness, intravenous drug use, and poor adherence to psychiatric treatment were independently associated with infection. These findings suggest that homelessness and psychiatric instability may jointly amplify vulnerability to blood-borne and sexually transmitted infections. Routine infectious disease screening, psychiatric stabilization, harm-reduction services, nutritional support, and linkage to appropriate treatment should be incorporated into integrated care models for this underserved population.

Declarations

Ethics declaration

Ethical approval was obtained from the institutional review board of Hainan Provincial Anning Hospital. Written informed consent was obtained from all participants or, when appropriate, from their legal guardians or authorized representatives.

Data availability

All the data will be provided upon reasonable request.

Patient and Public Involvement

Patients or the public WERE NOT involved in the design, or conduct, or reporting, or dissemination plans of our research

Declaration of Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Figures

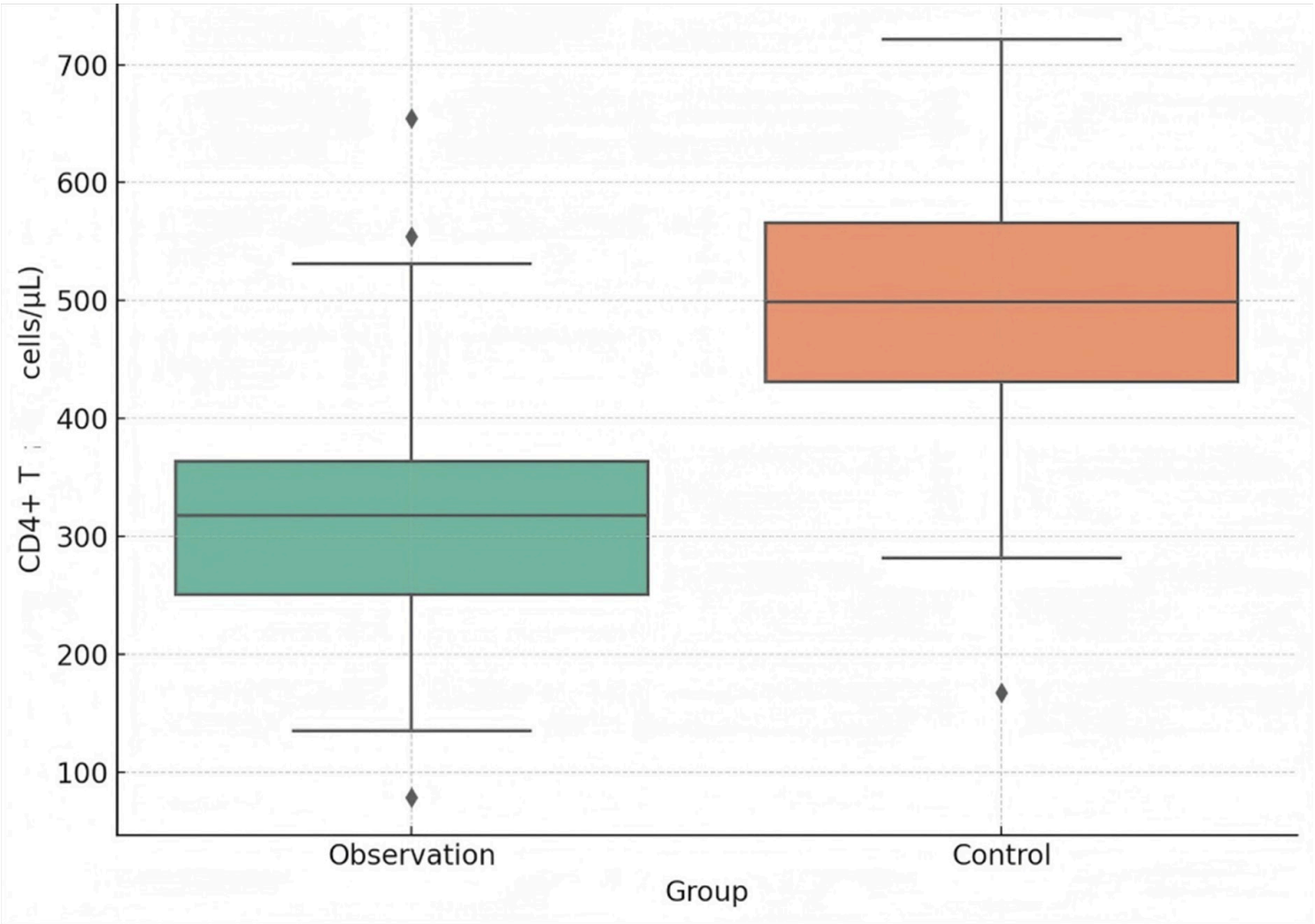


Figure 1

CD4⁺T-cell counts in homeless and non-homeless psychiatric patients

Box plot showing CD4⁺T-cell counts in the homeless group and the non-homeless control group. Homeless patients had significantly lower CD4⁺T-cell counts than controls (312 ± 89 vs. 498 ± 102 cells/μL; t = 5.672, P < 0.001). Boxes represent the interquartile range, horizontal lines indicate the median, and whiskers indicate the data range.

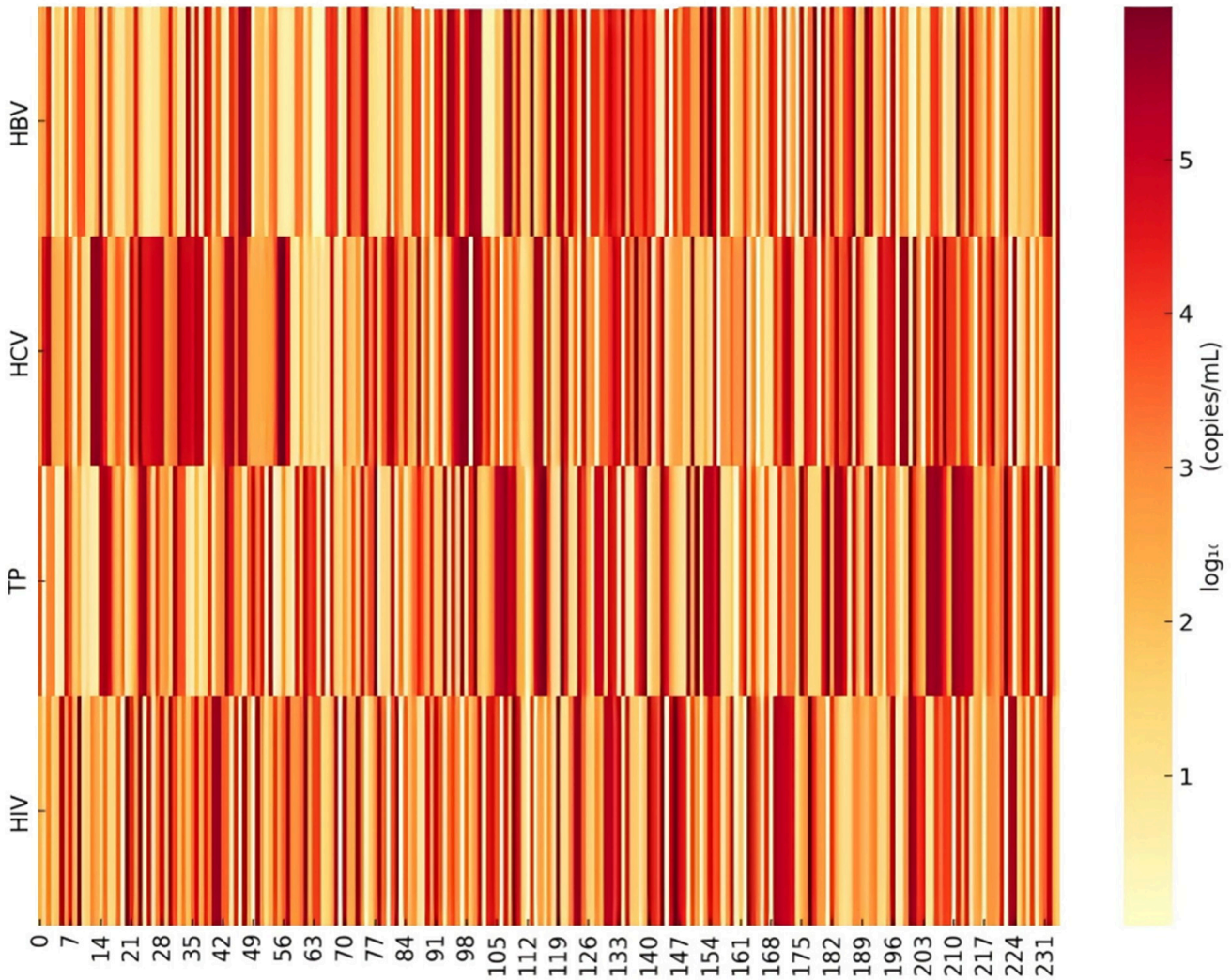


Figure 2

Viral load distribution among infected patients

Heatmap showing viral load distribution among patients with confirmed HBV or HCV infection. Each row represents an infected individual, and color intensity indicates viral load level. A subset of homeless patients showed elevated viral replication, suggesting greater potential infectiousness and disease activity.

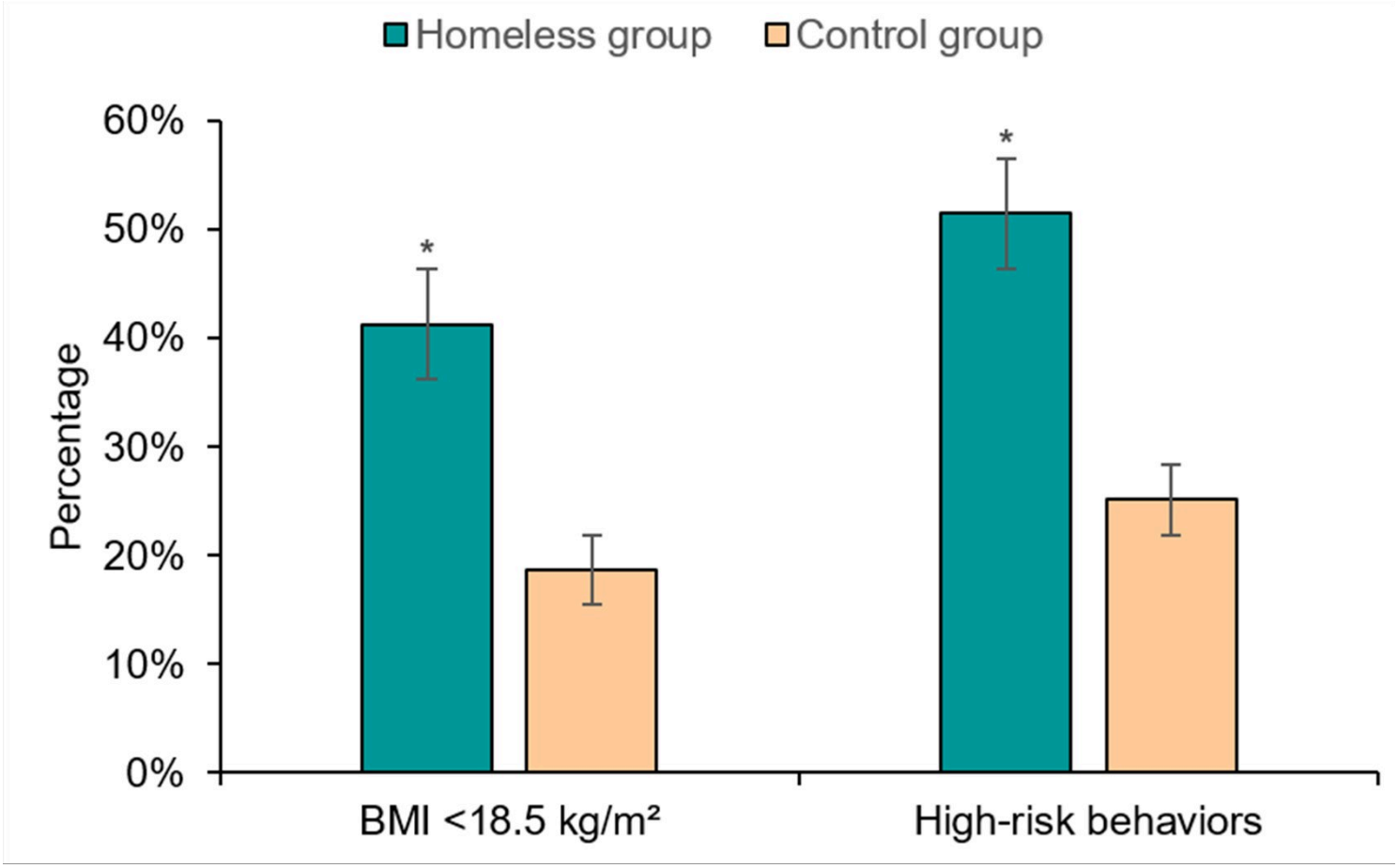


Figure 3

Nutritional status and high-risk behaviors in homeless and non-homeless psychiatric patients

Bar chart comparing the proportions of malnutrition and high-risk behaviors between the homeless group and the control group. Malnutrition was defined as BMI <18.5 kg/m². High-risk behaviors included unprotected sexual behavior and needle sharing. Homeless patients had significantly higher rates of both malnutrition and high-risk behaviors than controls. $P < 0.05$.