Tabari Biomedical Student Research Journal

OPEN ACCESS

ORIGINAL: Prevalence of Microbial Infections in HIV and AIDS Patients in the Population Covered by Mazandaran University of Medical Sciences

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ARTICLE INFO

Submitted: 13 Jul 2026
Accepted: 18 Aug 2026
Published: 19 Sep 2026

Keywords:
AIDS, HIV, microbial infections, serological markers; Iran

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Citation:
Mahdavi SA, Rezapour M, Ahanjan M, Najafinia F. Prevalence of microbial infections in HIV and AIDS patients in the population covered by Mazandaran University of Medical Sciences. Tabari Biomed Stu Res J. 2026;8(3): 50-57.

ABSTRACT

Infectious diseases are one of the most important problems of AIDS patients. Currently, there is no accurate information about the infectious complications associated with this disease in the population covered by Mazandaran University of Medical Sciences. The purpose of this study is to provide information about this in this geographical area.

The registered information was obtained from the health networks and health deputy of Mazandaran province and the website of the infectious disease management center of the Ministry of Health. After filtering, the collected data were entered into SPSS Ver 23 software. The distribution concerning the type of infection in HIV patients was analyzed based on GIS software.

In this study, 466 patients with AIDS were investigated. 184 patients were tested for hepatitis C (62%) had negative results and (38%) had positive results. In the investigation of hepatitis B cases, the rate of acute cases was 4.5%. Besides, 25.3% of AIDS patients had chronic hepatitis B. Additionally, 6% of patients had a history of tuberculosis, and isolated cases of rubella and syphilis (0.2% each) were also identified.

This study showed that the most common infections in people with HIV are hepatitis C and chronic hepatitis B, which require immediate action for prevention and treatment due to liver involvement in both cases.

Introduction

AIDS is a clinical syndrome caused by the human immunodeficiency virus. HIV weakens the immune system, making people more susceptible to various infections. Opportunistic infections, caused by microbes that usually don't cause illness in people with healthy immune systems, tend to be more common and severe in individuals with HIV/AIDS. The prevalence of microbial infections in HIV/AIDS patients can vary depending on several factors, including the immune status, access to healthcare, geographic location, and adherence to treatment. Some common infections seen in HIV/AIDS patients include bacterial

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infections, fungal infections, viral Infections, and parasitic Infections.

Besides, it leads to progressive immunodeficiency, various types of opportunistic infections, tumors, neurological disease, and diffuse body breakdown (1). The human immunodeficiency virus belongs to the group of enveloped RNA viruses and the family of retroviruses (2, 3). This virus has high infectivity and vulnerability. Likewise, it causes the weakness of the defense system and immunity of the human body. Until now, two types of this retrovirus are known as HIV-1 and HIV-2. It is worth pointing out that type 1 is more common around the world. (4, 5). Based on the report of the Joint United Nations Program on AIDS (UNAIDS), in 2017, nearly 36,900,000 people were infected with HIV. Additionally, there have been 940,000 AIDS-related deaths and 1,800,000 new HIV infections worldwide (6). In this regard, multiple sexual behaviors and consuming psychoactive drugs are the dominant factors that increase the risk of infection among young people (7). Other risk factors such as lack of circumcision, sexual activity during menstruation, bleeding, and mucosal damage during intercourse, increase the possibility of HIV transmission.

Symptoms associated with HIV can be both physical and psychological. People infected with HIV/AIDS suffer from fatigue, pain, dysfunction of peripheral nerves, nausea, loss of appetite, depression, and headache (8). Due to the involvement of T+CD4 immune cells in HIV people, the infection causes a gradual weakening of the body's immune system. Diagnosis of the acute initial stage is done by PCR-RT and P24 antigen methods. In any case, the infection should be finally confirmed by western blot. The standard criterion for proving HIV infection is at least one positive ELISA test and one positive Western blot test. The main point is that positive ELISA and western blot tests have more than 99% diagnostic sensitivity.

The recommended treatment for AIDS is called antiretroviral therapy (ART), which consists of taking a combination of HIV drugs (9). The goal of ART is to suppress the HIV viral load in the body. Infectious diseases are one of the most important problems of AIDS patients which occur due to immune system defects. Approximately one-third of all AIDS-related deaths worldwide are associated with TB and it is the primary cause of death in 10-15% of HIV-infected patients (10, 11).

It was estimated that 65% of HIV-infected patients face pulmonary involvement which lead to their first clinical presentation. The dominant issue is that approximately 80% of HIV-positive patients face lung disease during the period of HIV infection (12). The cause of lower respiratory tract bacterial infections (LRTIs) in HIV patients has been reported to be due to Streptococcus pneumoniae, Haemophilus influenzae, Pseudomonas aeruginosa, Staphylococcus aureus, Klebsiella pneumoniae, Mycobacterium tuberculosis and Acinetobacter species. Besides, bacteria such as Legionella pneumophila, Mycoplasma pneumoniae, and Chlamydia pneumoniae result in HIV-related pneumonia. In this case, opportunistic fungal infections such as mucosal candidiasis, pneumocystis, and cryptococcosis are the most common histoplasmosis diseases. Fungi such as Candida albicans, Cryptococcus neoformans, Histoplasma capsulatum, Coccidioides immitis, Aspergillus spp., Blastomyces dermatitidis, Penicillium marneffei, and Sporothrix schenckii can cause lung infection in people infected with HIV (13). Additionally, the etiological features of infectious diarrhea in HIV-infected people include bacteria, parasites, fungi, and intestinal viruses (14, 15). In this regard, intestinal bacterial pathogens, such as Salmonella species (especially Enterica serotypes), Shigella, Campylobacter and Escherichia coli, are the most common ones (16, 17). In more than 40% of cases, people with HIV infection have a 20- to 100-fold increased risk of salmonellosis and associated bacteremia. It is worth noting that in people with healthy immune system, Shigella gastroenteritis rarely progresses to bacteremia. However, up to 50% of AIDS

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patients suffer from shigellosis bacteremia (18, 19). Based on the national HIV control program, these patients are monitored by the behavioral disease counseling center at the provincial level. In particular, the burden of viral co-infections such as hepatitis B and C, rubella, and syphilis, together with tuberculosis, remains poorly characterized among people living with HIV/AIDS in this region. Currently, there is no accurate information about the clinical condition of patients and the infectious complications associated with the disease in the population covered by Mazandaran University of Medical Sciences. Thus, the researchers decided to investigate the patients who had cases in this realm.

Material and Methods

This was a descriptive study conducted on all HIV- positive cases and AIDS patients registered at the patient management center of Mazandaran Health Department from 2001 to 2021. The samples were included in the study by census. The registered information was obtained from the health networks and health deputy of Mazandaran province and the website of the infectious disease management center of the Ministry of Health. The data was entered into Excel from the registration portal of the care system, and the cases with information defects were corrected through the coordination of the program experts in that section.

Because the relevant data was extracted from the system of the Disease Management Center of the Health Vice-Chancellor of Mazandaran, the researchers might face some problems such as missing data, incomplete registration and incorrect registration. In cases where the percentage of missing was less than 5% of the total data, no special action was taken, and the researchers of the present study included all available cases in the analysis. It is worth noting that for cases where the missing was higher than 5%, the statistical method of the Expectation-Maximization (EM) algorithm was used to place the missing cases. For the cases that were entered as incomplete registration, the percentage and frequency were determined and mentioned in the limitations of the study. After the filtering process, the collected data were entered into SPSS software.

The relative frequency and chi-square test were used to compare and relate each of the independent and contextual variables with the dependent variable. Besides, polynomial logistic regression was used in this study. It was applied to determine the most important variables for determining the type of infection that a person with HIV has contracted. Likewise, the distribution of the type of infection in HIV patients was analyzed based on GIS software.

Results

In this study, 466 patients with AIDS were investigated. Regarding sex (Figure 1A), the cohort was predominantly male, with 339 patients (72.8%) compared to 127 female patients (27.2%). Concerning marital status (Figure 1B), married individuals constituted the largest identified group, accounting for 39.0% of patients. With respect to education level (Figure 1C), 49.4% of the cased were related to the school-aged were high school was the most frequently reported level of education (27.7%), followed by elementary education (21.7%), while the remaining 50.6% of patients fell into other or unspecified education categories.

The average age of the patients in this study was 45.6 ± 11.6 years. Among this population, 184 patients were tested for hepatitis C, 114 (62%) had negative results and 70 (38%) had positive results. Concerning hepatitis B cases, among the patients tested for HBS Ag, 189 negative cases (95.5%) and 9 positive cases (4.5%) were observed. Additionally, HBS Ab was done among 198 patients, which was negative in 148 cases (74.7%) and positive in 50 cases (25.3%). To restate, 25.3% of AIDS patients had chronic hepatitis B. Because of rubella infection, only one active case (0.2%) was detected by the IGM test. Besides, 8 patients (1.7%) had positive IgG, which shows cases of exposure in the past. Likewise, 12 patients (2.5%) were positive for rubella total antibody.

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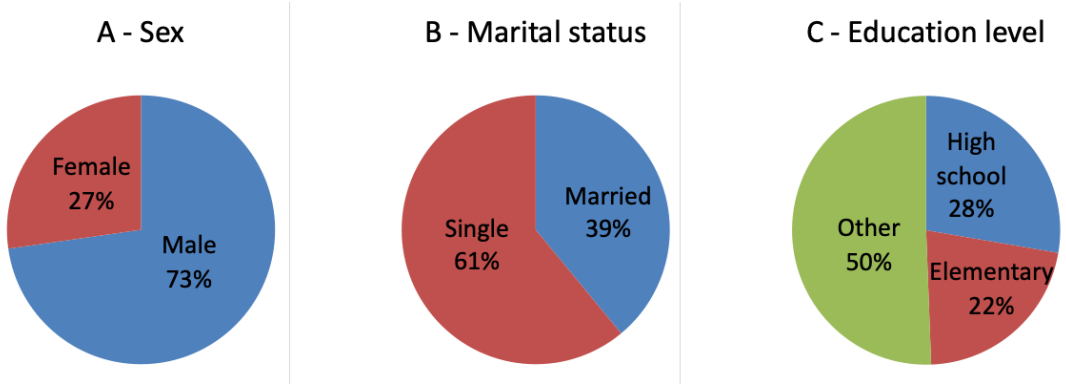


Figure 1. Demographic composition of the study population across three characteristics: sex, marital status, and education level.

Based on syphilis investigation with VDRL/PRP tests, only 1 positive case (0.2%) was found among the patients. Besides, 28 cases (6%) with a history of TB were identified. In this regard, 19 cases (4.1%) had recovered at the time of the study, 3 cases died and 6 cases (1.2%) were acute. The demographic characteristics of the study population are presented in Figure 1, and Table 1 summarizes the prevalence of the co-infections and serological markers examined.

Table 1. Prevalence of co-infections and serological markers among HIV/AIDS patients

Marker	Positive, n (%)	Negative, n (%)	Tested, N
Anti-HCV	70 (38.0%)	114 (62.0%)	184
HBsAg	9 (4.5%)	189 (95.5%)	198
HBsAb	50 (25.3%)	148 (74.7%)	198
Rubella IgM	1 (0.2%)	—	466
Rubella IgG	8 (1.7%)	—	466
Rubella, total antibody	12 (2.5%)	—	466
Syphilis (VDRL/RPR)	1 (0.2%)	—	466
History of Tuberculosis	28 (6.0%)	—	466

Discussion

In this study, 466 patients with AIDS were investigated, most of them (72.8%) were men and (27.2%) were women. It is worth noting that in a study conducted by Naghibifar, Taheri, and Haji Abdulbaghi, the majority of patients (77.3%, 87.9%, and 84.3%) were men, which is consistent with the current study in this regard (20-22).

Concerning gender, in Ayele and Gebretsadik's study, the majority of patients (53.3%, 68.6%) were women, which differs from the present investigation (23, 24). The gender distribution of any society can specify the number of cases concerning unprotected sex, multiple partners, and injection addiction among women or men. In the current study, the mean age of the patients was 45.6 ± 11.6 years. In previous studies, it has been showed that the average age of the patients was 44.24 ± 9.46, 39.7 ± 7, and 38.7, respectively, which is lower than the average of the present study (20, 25, 26). More involvement among the young and middle-aged population is the most important point, as it can help direct educational programs to recognize this issue and plan for infection prevention. Thus, they can reduce various cases of infection via training classes, distribution of sexual transmission prevention devices, and free distribution of syringes among high-risk populations.

In the present study, the majority of patients (39%) were married while the remaining 61.0% belonged to other marital status categories that were not further broken down in the registry data. In the study of Naghibifar et. al., it is reported that the majority of patients (67.3%) were single (20). In the studies of Taheri et. al., and Gebretsadik et.

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al., the majority of patients were married (83.87% and 53%, respectively), which was similar to the present study (21, 24). The main point is that higher prevalence among married patients requires serious measures. Because in the case of sexual transmission to spouse or transmission from mother to child, it can lead to a significant increase in the prevalence rate. In the current study, the majority of patients had high school and elementary education (27.7% and 21.7%, respectively). In the study of Falahi et. al., 65.4% of patients had primary or secondary education, which is in line with the current study in this field (27). It is worth noting that, the higher number of infections among people with lower education can highlight the main role of education in preventing infectious diseases and sexually transmitted diseases.

On the other hand, it signifies the role of social level and economic status of the people for this kind of infection in the society. In the current investigation, 184 patients were tested for hepatitis C, most of them (62%) had negative results. In this realm, Naghibifar et al., and Azimi, et al., showed that (31.5% and 3%) were infected with hepatitis C, which was less than the statistics of the current study (20, 25). The point is that Chronic Hepatitis C (CHC) can lead to progressive liver fibrosis and cirrhosis and put patients at risk of developing liver cancer and liver failure (28). Likewise, this virus is associated with several extrahepatic manifestations. Patients with HCV may develop mixed cryoglobulinemia, cutaneous and visceral vasculitis, glomerulonephritis, and B-cell non-Hodgkin's lymphoma. Additionally, insulin resistance, diabetes, and atherosclerosis increase in these patients which may lead to increased cardiovascular complications and mortality (29). Consequently, high CHC cases in our society can represent a worse prognosis and higher mortality and morbidity of patients with HIV in Mazandaran province. It seems crucial to take necessary measures to prevent infection and screen cases of infection in patients with HIV.

In the present study concerning the examination of hepatitis B cases, among patients tested for HBS Ag, the findings highlighted that (95.5%) were negative and (4.5%) were positive, in other words, the rate of acute cases was 4.5%. Regarding Naghibifar's study, 98 people (3.2%) were infected with hepatitis B, which was less than the positive cases in the present study (20). Likewise, in this study, 25.3% of AIDS patients had chronic hepatitis B. In Taheri's study, 6.45% of AIDS patients had hepatitis B, which was less than the present study (21). Besides, in the study of Azimi et. al., study showed that the total number of acute and chronic hepatitis B cases was 45% which was higher than the total amount in the current study (25).

It is worth noting that in chronic hepatitis B, cirrhosis may also develop due to repeated attacks of the immune system. It is common to progress from compensated cirrhosis to decompensated cirrhosis without treatment. It is associated with the cessation of enzymatic processes in the liver and subsequent severe clinical complications such as fluid retention in the abdomen (ascites), jaundice, internal bleeding, and hepatic encephalopathy. Patients with decompensated cirrhosis are candidates for liver transplantation; thus, without liver transplantation death is the final stage (30).

The main issue is that lack of timely awareness of chronic hepatitis B is in the second rank for the prevalence of infections diagnosed in AIDS patients in Mazandaran province. Besides, this issue can be associated with additional comorbidity and mortality. Hence, identifying the main transmission route and preventing of infection are helpful solutions to improving the life span and life quality of affected patients.

In the current study, one case of rubella (0.2%) and one case of syphilis (0.2%) were detected among the patients. The significant issue is that such cases were not found in similar studies searched in electronic databases such as Google Scholar and PubMed. In the present investigation, 28 cases (6%) had a history of tuberculosis (TB). Concerning tuberculosis, 19 cases (4.1%) had recovered at the time of the study, 3 cases died

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and 6 cases (1.2%) were acute. In the studies of Naghibifar et. al., and Mohammad Nejad et. al., respectively, 13.6% and 28.2% were suffering from tuberculosis which was more than the current study (20, 31). The significant point is that immunodeficiency in AIDS patients enhances the risk of spreading TB to other organs. Based on liver metabolism, the therapeutic diet used in TB patients can cause a very poor prognosis in case of simultaneous infection with other infections such as hepatitis. Likewise, drug interaction with antiviral drugs used in AIDS patients with TB treatment diet can be another important concern in this regard.

Overall, the findings emphasize the importance of integrated screening and management of infectious comorbidities among people living with HIV. In particular, hepatitis screening and appropriate follow-up of patients with positive HBsAg or anti-HCV results may facilitate early diagnosis and treatment, while continued tuberculosis screening and management should remain an important component of HIV care.

This study has several strengths and limitations. A major strength is the use of a provincial HIV/AIDS registry covering a 20-year period and including 466 registered patients, providing valuable regional information on selected infectious conditions among people living with HIV in Mazandaran Province. However, the retrospective nature of the study meant that the analysis depended on the completeness and accuracy of routinely collected registry data. Testing coverage also differed among the investigated conditions. Anti-HCV and HBV testing were available for only 184 and 198 patients, respectively; therefore, these estimates should not be assumed to represent the entire cohort. In addition, anti-HCV positivity cannot distinguish active from resolved infection without HCV RNA testing, while the available HBV markers were insufficient to distinguish acute, chronic, resolved, and vaccine-related infection. The interpretation of rubella, syphilis, and tuberculosis findings is also limited by the need to confirm the number of patients actually screened for each condition. Furthermore, important clinical variables, including CD4+ T-cell count, HIV viral load, ART status, and detailed transmission-risk factors, were unavailable or incompletely recorded. Finally, because the study population was derived from a single province, the findings may not be directly generalizable to other regions of Iran.

Despite these limitations, the study provides useful baseline epidemiological information on selected infectious conditions among HIV-positive patients and patients with AIDS in Mazandaran Province. Future prospective or registry-based studies with more complete laboratory and clinical data, including CD4+ T-cell counts, HIV viral load, ART status, HCV RNA, and comprehensive HBV serological profiles, would allow a more detailed assessment of the prevalence, determinants, and clinical consequences of these coinfections.

Conclusion

This descriptive study of 466 HIV/AIDS patients registered with Mazandaran University of Medical Sciences highlights hepatitis C (38%) and chronic hepatitis B (25.3%) as the most prevalent co-infections, alongside a history of tuberculosis in 6% of patients and comparatively rare cases of rubella and syphilis. These findings are broadly consistent with the co-infection patterns reported in other Iranian and international HIV/AIDS cohorts, while highlighting a comparatively higher hepatitis B and C burden among AIDS patients in this province. Given the shared risk of liver-related morbidity across these infections, routine hepatitis screening, vaccination where applicable, and integrated hepatitis/TB management should be prioritized within HIV care programs in the region. Future studies incorporating CD4 count, antiretroviral therapy status, and the regression-based and geographic analyses planned for this dataset would help clarify the risk factors driving these co-infection patterns.

Acknowledgments

The authors would like to thank the staff of

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Mazandaran University of Medical Sciences and the Mazandaran Health Department for their valuable cooperation and assistance in providing the data required for this study.

Authorship

All authors meet the ICMJE authorship criteria.

Conflicts of interest

The authors declared no conflict of interest.

Funding

There is no funding source for this study.

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