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NEUROLOGICAL MANIFESTATIONS IN HIV-POSITIVE INMATES WITHIN  
AZERBAIJANI CORRECTIONAL FACILITIES

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A cross-sectional study recruited 376 incarcerated individuals from Azerbaijani penitentiary institutions, including 257 human immune deficiency virus (HIV)-positive (main group) and 119 HIV-negative participants (control group). Clinical, neurological, and psychological evaluations were conducted using standardized tools, adapted for the local context. The main group had shorter sentences, with 36.6 % serving  $\leq 1$  year, (14.3 % in the control group ( $p < 0.001$ )), and a higher proportion with only secondary education (77.0 % vs. 42.9 %,  $p < 0.001$ ), higher rates of infectious diseases, and 64.6 % with drug addiction (vs. 5.9 %,  $p < 0.001$ ). Cognitive impairments and neurological disorders, including dementia, were more prevalent in the main group, with 41.3 % showing any dementia (vs. 21.0 % in the control group,  $p < 0.001$ ). Quality-of-life assessments showed lower scores in the main group. HIV-infected prisoners experience significantly worse cognitive function, higher rates of infectious and psychological comorbidities, and a lower quality of life compared to non-infected inmates.

**Key words:** HIV, polyneuropathy, HIV-associated neurocognitive disorder, quality of life.

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НЕВРОЛОГІЧНІ ПРОЯВИ У ВІЛ-ПОЗИТИВНИХ УВ'ЯЗНЕНИХ  
У ВИПРАВНИХ ЗАКЛАДАХ АЗЕРБАЙДЖАНУ

У поперечному дослідженні взяли участь 376 ув'язнених пенітенціарних установ Азербайджану, включаючи 257 ВІЛ-інфікованих (основна група) і 119 ВІЛ-негативних (контрольна група). Клінічне, неврологічне та психологічне обстеження проводилося з використанням стандартизованих інструментів, адаптованих до місцевих умов. Основна група характеризувалася більш короткими термінами ув'язнення: 36,6 % відбували покарання терміном до 1 року (14,3 % в контрольній групі ( $p < 0,001$ )), а також більш високою часткою осіб із середньою освітою (77,0 % проти 42,9 %,  $p < 0,001$ ), вищим рівнем інфекційних захворювань, 64,6 % страждали на наркоманію (проти 5,9 %,  $p < 0,001$ ). Когнітивні порушення та неврологічні розлади, включаючи деменцію, були більш поширені в основній групі: 41,3 % мали різні форми деменції (проти 21,0 % у контрольній групі,  $p < 0,001$ ). Оцінка якості життя показала нижчі бали в основній групі. У ВІЛ-інфікованих ув'язнених спостерігається значне зниження когнітивних функцій, вища частота супутніх інфекційних і психологічних захворювань, а також нижча якість життя в порівнянні з неінфікованими ув'язненими.

**Ключові слова:** ВІЛ, полінейропатія, ВІЛ-асоційований нейрокогнітивний розлад, якість життя.

In Azerbaijan, as in many parts of the world, human immunodeficiency virus (HIV) remains a significant public health concern, particularly among vulnerable populations such as prisoners. Globally, the prevalence of HIV in prisons is substantially higher than in the general population. According to the World Health Organization (WHO), the global prevalence of HIV among prisoners is estimated to be 3–5 times higher than in the general public [15]. This disparity is particularly pronounced in low- and middle-income countries where HIV prevalence in prisons can exceed 10 % in some regions. In Azerbaijan, the prison population has also been disproportionately affected by HIV, with the prevalence of HIV infection being higher than that in the general community. The prevalence of HIV among prisoners in Azerbaijan is between 3.7 % and 5.4 % [2, 4]. However, due to successful educational programs and initiatives, the number of new HIV cases in the incarcerated population has significantly dropped, from 2 % to 0.2 % between 2010 and 2017 [9]. Prison populations are at a heightened risk of HIV infection due to behavioral and structural factors, including high rates of injection drug use and unprotected sexual activity. Sharing needles in prisons significantly increases HIV transmission, while sexual violence and lack of privacy further elevate the risks. Overcrowded and unsanitary conditions in prisons limit access to healthcare, exacerbating HIV transmission. These factors collectively create a critical need for comprehensive prevention and care strategies for HIV-positive prisoners [14].

Once incarcerated, individuals with HIV face significant barriers to care. The availability of antiretroviral therapy (ART) in prisons is often limited, and treatment adherence can be challenging due to the stressful and restrictive environment. In many prison settings, medical services are inadequate, with long delays in receiving necessary care, including HIV testing and treatment. Additionally, the stigma surrounding HIV often leads to social isolation and discrimination, further hindering access to care. This is particularly true in countries like Azerbaijan, where there is still significant stigma surrounding HIV, making it difficult for prisoners to seek support or receive adequate treatment [11].

Prisoners with HIV may have difficulty accessing mental health care, which is critical for managing both the psychological impact of HIV and the challenges posed by incarceration. Mental health issues such as depression, anxiety, and substance use disorders are common among prisoners and can affect adherence to ART, leading to poor health outcomes [5]. In Azerbaijan, the lack of mental health services within prisons is an additional barrier to comprehensive HIV care [9, 12].

HIV has significant neurological effects, including HIV-associated neurocognitive disorders (HAND), peripheral neuropathy, and central nervous system infections, which are particularly prevalent among prisoners. HAND, which involves cognitive, motor, and mood disturbances, is more common in incarcerated individuals due to the stressful and poor living conditions. Peripheral neuropathy, causing pain and numbness, is exacerbated by substance abuse and malnutrition in prisoners with HIV [7]. Infections like toxoplasmosis and cryptococcal meningitis are also more frequent in HIV-positive prisoners, often due to delays in accessing proper healthcare [6]. These compounded challenges highlight the need for better healthcare and neurological support for HIV-positive prisoners.

**The purpose** of the study was to explore the neurological complications of HIV-infected individuals in Penitentiary Institutions of Azerbaijan, assessing their prevalence, impact on health, and the effectiveness of existing healthcare interventions.

**Materials and methods.** The study was conducted by the Department of Neurology at Azerbaijan Medical University during 2021–2025. A cross-sectional design was used to recruit incarcerated individuals in Penitentiary Institutions of Azerbaijan within the same period (2021–2025). It involved a cohort of 376 individuals: 257 with HIV and clinically diagnosed neurological disorders were included in the primary group, while the control group consisted of 119 HIV-negative inmates. The study was approved by the Azerbaijan Medical University Ethics Committee (P.23/19.05.2022), and all participants provided written informed consent.

Data collection involved a multi-faceted approach, including clinical and laboratory assessments. These encompassed sociodemographic information, HIV disease stage, antiretroviral therapy (ART) adherence, and comorbid conditions. Neurological evaluations primarily focused on identifying cognitive and motor dysfunction, employing standardized tools such as the Michigan Neuropathy Screening Instrument (MNSI) and the Mini-Mental State Examination (MMSE).

To assess emotional well-being and quality of life, participants were evaluated using the Hospital Anxiety and Depression Scale (HADS), the EQ-5D-5L, and the SF-36. All assessments were conducted face-to-face by research staff using standardized instruments translated and back-translated into Azerbaijani, with adaptations to the national context.

Descriptive statistics were used to summarize demographic, clinical, and psychological variables. Categorical variables (e.g., gender, presence of neurological or infectious diseases, educational level, sentence length) were compared between the control and main groups using Pearson's chi-square ( $\chi^2$ ) test. When appropriate, degrees of freedom (df) and exact p-values were reported. A p-value <0.05 was considered statistically significant. For continuous variables (e.g., quality-of-life scores), comparisons between groups were conducted using one-way analysis of variance (ANOVA). When normality assumptions were violated, nonparametric alternatives such as the Kruskal-Wallis test and the Mann-Whitney U test were applied. This included EQ-5D-5L utility scores, Visual Analogue Scale (VAS) scores for self-rated health, and SF-36 health survey subscales. ANOVA F-statistics, degrees of freedom, and p-values were reported for each comparison. Psychological distress was assessed using the Hospital Anxiety and Depression Scale (HADS), and cognitive function was measured using the Mini-Mental State Examination (MMSE). MMSE scores were analyzed categorically based on defined clinical thresholds (e.g., no cognitive impairment, mild impairment, dementia) and compared between groups using chi-square tests. HADS subscale scores were categorized by severity (normal, mild, moderate, severe) and similarly analyzed using chi-square. All statistical tests were two-tailed. To conduct the data analysis, we used IBM SPSS Statistics 22.0.

**Results of the study and their discussion.** The analysis included 119 individuals in the control group and 257 individuals in the main group. Table 1 presents a comparative analysis between a control group and an HIV-infected prisoner group. The distribution of gender did not significantly differ between groups, with males comprising 96.6 % of the control group and 96.9 % of the main group ( $\chi^2=0.016$ ;  $p=0.899$ ). The gender distribution did not differ, indicating homogeneity in male dominance within incarcerated populations, consistent with national incarceration trends. In the control group, 52.1 % of individuals were aged 18–35 years, whereas the main group primarily consisted of individuals aged 36–55 years (78.6 %).

Incarceration duration differed markedly between groups ( $\chi^2=44.488$ ,  $p<0.001$ ). The majority of the main group had shorter sentences ( $\leq 1$  year: 36.6 %; 1–5 years: 38.1 %), while the control group had a greater proportion serving longer sentences (6–10 years: 36.1 %; >10 years: 21.8 %). Educational levels also significantly varied ( $\chi^2=71.862$ ,  $p<0.001$ ), with most participants in the main group having completed only secondary education (77.0 %), compared to a more diverse distribution in the control group (Table 1).

Table 1

## Comparative Characteristics between patients of control and main groups

Variable	Control Group (n=119) % (abs.number)	Main Group (n=257) % (abs.number)	p-value
Gender (Male)	96.6 % (115)	96.9 % (249)	0.899
Sentence ≤ 1 year	14.3 % (17)	36.6 % (94)	<0.001
Secondary Education	42.9 % (51)	77.0 % (198)	<0.001
Tension-type Headache	18.5 % (22)	14.0 % (36)	0.263
Polyneuropathy	5.0 % (6)	7.0 % (18)	0.469
Epilepsy	0.0 % (0)	1.2 % (3)	0.237
Hepatitis B	2.5 % (3)	7.8 % (20)	0.048
Hepatitis C	6.7 % (8)	75.1 % (193)	<0.001
Tuberculosis	0.0 % (0)	29.2 % (75)	<0.001
Syphilis	0.8 % (1)	5.8 % (15)	0.026
Drug Addiction	5.9 % (7)	64.6 % (166)	<0.001
Herpes Zoster	0.0 % (0)	26.8 % (69)	<0.001
MMSE – Any Dementia	21.0 % (25)	41.3 % (106)	<0.001
HADS-D	28.6 % (34)	38.9 % (100)	0.010
HADS-A	26.9 % (32)	41.2 % (106)	0.011

Note: HADS –D Hospital Anxiety and Depression Scale Depression subscale, HADS –A- Hospital Anxiety and Depression Scale Depression Anxiety subscale, MMSE- Mini-Mental State Examination.

No significant differences were found in the prevalence of tension-type headaches, polyneuropathy, or post-concussion syndrome. Cognitive evaluation using the MMSE scale revealed statistically significant differences ( $\chi^2=22.220$ ,  $p<0.001$ ), with mild cognitive impairment and various degrees of dementia more frequently observed in the main group.

The main group demonstrated significantly higher rates of infectious diseases. Hepatitis B was present in 7.8 % of the main group compared to 2.5 % in the control group ( $\chi^2=3.920$ ;  $p=0.048$ ). Hepatitis C was found in 75.1 % of the main group and only 6.7 % in the control group ( $\chi^2=152.835$ ;  $p<0.001$ ). Tuberculosis (29.2 % vs. 0 %;  $p<0.001$ ), syphilis (5.8 % vs. 0.8 %;  $p=0.026$ ) were also significantly more prevalent in the main group. Herpes zoster was present in 26.8 % of the main group, whereas it was not reported in the control group ( $\chi^2=39.130$ ;  $p<0.001$ ). Substance abuse showed one of the most striking differences, with drug addiction present in 64.6 % of the main group versus 5.9 % in the control group ( $\chi^2=112.859$ ;  $p<0.001$ ).

Psychological distress, as assessed by the HADS-D and HADS-T scales, revealed a significantly higher prevalence of depressive ( $\chi^2=11.408$ ;  $p=0.010$ ) and anxiety symptoms ( $\chi^2=10.798$ ;  $p=0.013$ ) in the main group, including a greater incidence of moderate severity.

Quality of life was assessed using multiple standardized tools, including the EQ–5D–5L, the Visual Analogue Scale for current health status (“Your health today”), and the SF–36 health survey. The results indicated that individuals in the main group had significantly lower quality of life than those in the control group across several domains. Specifically, the EQ–5D–5L scores were significantly lower in the main group, reflecting a poorer perceived overall health state ( $F(1,374)=11.420$ ;  $p=0.001$ ). Similarly, the self-assessment of current health status using the visual analogue scale was markedly worse among the main group ( $F(1,374)=20.145$ ;  $p<0.001$ ), highlighting a notable decline in perceived health and well-being.

Further analysis of SF–36 subscales revealed significant impairments in multiple domains of functioning in the main group. Physical functioning (PF) was significantly reduced ( $F(1,374)=13.139$ ;  $p<0.001$ ), as were general health perceptions (GH) ( $F(1,374)=7.744$ ;  $p=0.006$ ), indicating a broader sense of physical limitation and poor overall health (Table 2).

Social functioning (SF) was also significantly lower in the main group ( $F(1,374)=4.244$ ;  $p=0.040$ ), suggesting diminished social engagement and interaction. Additionally, mental health (MH) scores were significantly reduced among participants in the main group ( $F(1,374)=7.449$ ;  $p=0.007$ ), reflecting elevated psychological distress or reduced emotional well-being.

However, other domains did not show statistically significant differences. These included role limitations due to physical health problems (RP) ( $F(1, 374)=3.289$ ;  $p=0.071$ ), bodily pain (BP) ( $F(1,374)=0.020$ ,  $p=0.888$ ), vitality (VT) ( $F(1,374)=0.839$ ;  $p=0.360$ ), and role limitations due to emotional problems (RE) ( $F(1,374)=0.425$ ;  $p=0.515$ ). This suggests that while general health, physical and social functioning, and mental well-being were significantly compromised, some specific functional limitations and pain-related aspects did not differ significantly between the groups.

Overall, these findings highlight a considerable burden on the quality of life in the main group compared to the control group, with implications for targeted interventions aimed at improving both physical and mental health outcomes in vulnerable populations.

SF-36 Subscale Scores in patients of main and control groups

HRQoL Domain	Control group (Mean±SD)	Main group (Mean±SD)	p-value
Physical Functioning (PF)	70.3±22.2	60.7±24.6	<0.001
Role Physical (RP)	48.7±47.1	39.3±46.8	0.071
Bodily Pain (BP)	64.0±26.0	63.6±25.0	0.888
General Health (GH)	51.0±19.8	44.4±21.9	0.006
Vitality (VT)	48.6±21.5	46.3±22.2	0.360
Social Functioning (SF)	68.1±23.9	62.5±25.2	0.040
Role Emotional (RE)	47.3±48.8	43.8±47.2	0.515
Mental Health (MH)	52.3±15.2	46.7±19.7	0.007

Since 2010, Azerbaijan has demonstrated substantial progress in addressing the HIV epidemic [13]. The number of new HIV infections has declined by 36 %, while AIDS-related mortality has decreased by 76 %, indicating a positive trajectory in epidemic control and in improving health outcomes for people living with HIV [9]. This trend has coincided with a significant expansion of antiretroviral therapy (ART) coverage and HIV testing, which increased from 16 % in 2012 to 71 % in 2017. As of 2019, ART coverage among incarcerated individuals reached 91.8 %, reflecting strong institutional efforts to ensure access to essential treatment and to curb the transmission of HIV within correctional facilities [14].

This study presents a comprehensive comparison of sociodemographic, neurological, psychological, and quality of life indicators between HIV-infected prisoners and a non-infected control group. The stark disparity in incarceration duration and education levels reflects the broader socioeconomic vulnerabilities of the HIV-infected population. Lower education levels among the main group may be a contributing factor to poor health literacy, limited access to preventative care, and delayed HIV diagnosis or treatment [8].

Golrokhi R, et al (2018) in their study analyzing sociodemographic and clinical characteristics among people with diagnosed HIV found that individuals with a history of incarceration often had lower education levels, which correlated with challenges in accessing and adhering to HIV care [6]. The pronounced difference in incarceration duration reflects the broader socioeconomic vulnerabilities of the HIV-infected population.

Study of Altice et al. (2016), had consistently shown that individuals living with HIV, particularly those who inject drugs or face poverty, homelessness, and marginalization, are at greater risk of repeated or prolonged incarceration [1]. In Azerbaijan, national reports highlight that HIV-infected prisoners often come from disadvantaged backgrounds, with a high prevalence of unemployment, low educational attainment, and prior histories of substance abuse [13]. These interconnected factors not only predispose individuals to criminal justice involvement but also create barriers to timely healthcare access and continuity of HIV care after release [14].

Neurological assessments showed no statistically significant difference in the prevalence of some conditions, such as tension-type headaches and polyneuropathy. However, cognitive impairment, as assessed by the MMSE, was significantly higher among the main group, pointing to possible neurocognitive sequelae of chronic HIV infection, as well as potential neurotoxic effects of substance abuse and antiretroviral therapy. Neurological and cognitive impairments are increasingly recognized as significant health concerns among incarcerated individuals living with HIV. A recent study found that over one-third of people living with HIV/AIDS exhibited cognitive problems, with comorbid medical conditions, unemployment, and low educational attainment identified as key risk factors [5, 15].

A striking finding of the study is the markedly higher burden of infectious comorbidities – including Hepatitis B virus (HBV), Hepatitis C virus (HCV), tuberculosis (TB), and syphilis – among HIV-infected inmates. These conditions are known to be highly prevalent in correctional settings, where factors such as overcrowding, inadequate access to healthcare, and high rates of intravenous drug use act as catalysts for transmission [1, 3]. Furthermore, alcohol-related liver disease is also a significant factor [10]. Our findings align with global and regional epidemiological patterns, which consistently report elevated co-infection rates among HIV-positive incarcerated populations [1]. Data from Azerbaijan further support these observations: according to the Republican AIDS Center and the Ministry of Justice, high rates of HIV, HCV, TB, and sexually transmitted infections have been documented among inmates, with intravenous drug use cited as a primary driver of co-infection [2, 13]. The synergistic interactions between these infections exacerbate disease progression and complicate treatment strategies, emphasizing the urgent need for integrated health interventions within penitentiary systems.

Psychological distress was significantly more prevalent in the main group, as evidenced by higher scores on both the HADS-D and HADS-T scales. This supports existing evidence that mental health disorders are more common in people living with HIV, exacerbated further by the stressors of incarceration,

social isolation, and stigma. Furthermore, studies have highlighted the challenges faced by incarcerated individuals with co-occurring HIV and psychiatric disorders, noting that the prison environment can exacerbate these conditions [5]. Comprehensive treatment strategies that simultaneously target HIV, substance use disorders, and mental health conditions are crucial for effectively addressing the complex healthcare needs of this population.

Notably, in our findings, certain domains – such as Bodily Pain (BP), Vitality (VT), and Role-Emotional (RE) – did not differ significantly between the groups. This observation may suggest that some aspects of functioning are equally affected by incarceration itself, regardless of HIV status, or that these domains are the less sensitive markers of the health burden associated with HIV in the penitentiary setting [14, 15].

Collectively, these findings emphasize the heightened vulnerability of HIV-infected prisoners to adverse health outcomes and reduced quality of life. Addressing these disparities requires a multidimensional approach that integrates infectious disease management, mental health care, substance use treatment, and rehabilitation services. Policy-level changes are also warranted to ensure continuity of care post-incarceration, reduce recidivism, and support reintegration into society.

### Conclusions

1. The (HIV)-positive (main) group had shorter sentences, with 36.6 % serving  $\leq 1$  year, (14.3 % in the (HIV)-positive (control) group ( $p < 0.001$ )), and a higher proportion with only secondary education (77.0 % vs. 42.9 %,  $p < 0.001$ ), higher rates of infectious diseases, and 64.6 % with drug addiction (vs. 5.9 %,  $p < 0.001$ ).

2. Cognitive impairments and neurological disorders, including dementia, were more prevalent in the main group, with 41.3 % showing any dementia (vs. 21.0 % in the control group,  $p < 0.001$ ). Quality-of-life assessments showed lower scores in the main group.

HIV-infected prisoners experience significantly worse cognitive function, higher rates of infectious and psychological comorbidities, and a lower quality of life compared to non-infected inmates. These findings highlight the urgent need for integrated medical, mental health, and social support services within penitentiary systems. Targeted interventions could improve outcomes and reduce long-term health disparities in this vulnerable population.

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