

HEALTH EDUCATION ASPECTS OF HIV/AIDS PREVENTION
IN HIGHER NON-MEDICAL EDUCATION OF UKRAINE

Shevchenko A.S.^{1,2}, Shevchenko V.V.^{3,4}, Shumskyi O.L.⁵

¹Kharkiv National Medical University, Kharkiv, Ukraine

²Kharkiv Regional Institute of Public Health Services, Kharkiv, Ukraine

³V.N. Karazin Kharkiv National University, Kharkiv, Ukraine

⁴National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine

⁵Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine

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ABSTRACT

Background. HIV infection remains one of the most serious medical and social problems of our time, despite significant progress in treatment and prevention. In Ukraine, the epidemic has specific features, including a close link with injecting drug use, and the war creates additional challenges: population displacement, destruction of infrastructure, and limited access to testing. The educational environment is optimal for forming safe behavior among young people, but issues of students' awareness of HIV transmission routes, risks, and prevention remain insufficiently studied.

Aim. To assess the knowledge of adult non-medical students of higher education institutions in Kharkiv about risk factors for HIV infection, testing opportunities, treatment, causes and consequences of stigma and discrimination against HIV-infected people.

Materials and Methods. A cross-sectional analytical study was conducted using data from two independent samples of students ($n=405$). Group 1 (face-to-face training, 2004–2007) comprised 226 students; Group 2 (distance learning, 2019–2022) – 179 students. A standardized questionnaire-test consisting of two blocks (knowledge and behavioral models) was used to assess awareness. Statistical analysis was performed using SPSS 27.0 (IBM, USA); χ^2 test and Pearson's correlation coefficient (φ) were applied. The study was carried out as a private initiative of the authors, without grant support or state registration of the topic.

Research Ethics. The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki (1964–2024) and was approved by the Ethics Committee of the Kharkiv Regional Institute of Public Health Services (Protocol No.1 of January 14, 2004, and Protocol No.1 of January 17, 2019). All participants provided written informed consent to participate in the study.

Results. The level of awareness about HIV transmission routes increased from 30.5% in 2004–2007 to 43.2% in 2019–2022 ($p<0.001$). Increases were observed for risks of injecting drug use (from 31.9% to 44.7%), unprotected sex (from 32.7% to 44.1%), the need for testing (from 30.1% to 39.7%), and testing availability (from 30.1% to 40.2%). At the same time, awareness of treatment decreased from 29.6% to 20.1%, and awareness of the absence of a vaccine from 39.4% to 29.6% ($p<0.05$). Condom use increased from 29.6% to 59.8% ($p<0.001$); unprotected sex decreased from 22.1% to 16.2% ($p<0.05$). The proportion of students who knew their HIV status decreased from 20.4% to 13.4% ($p<0.05$). Injecting drug use increased from 2.2% to 3.9% ($p<0.05$). Awareness of stigma increased from 24.8% to 37.4% ($p<0.001$); cases of participation in stigmatization decreased from 0.9% to 0.6%. Face-to-face training proved more effective for knowledge formation than distance learning.

Conclusions. Despite positive changes in awareness about HIV transmission routes and safe sex practices, the decline in awareness about treatment, absence of a vaccine, and knowledge of one's own HIV status are alarming signals. The obtained results indicate the need to strengthen targeted prevention measures among young people, especially in the context of war and distance learning.

Keywords: *nutrition, dietary fiber, inflammatory intestinal diseases.*

Corresponding Author:

Shevchenko Alexander S. – MD, MM,E&P,
Director of the Kharkiv Regional Institute
of Public Health Services.

✉ 4, Nauky ave., Kharkiv, 61022, Ukraine.

E-mail: as.shevchenko@knmu.edu.ua

Introduction

HIV infection (disease caused by the Human Immunodeficiency Virus) is one of the greatest threats to human existence over the past 30 years [1], despite progress in treatment and prevention. The HIV/AIDS pandemic (Acquired Immunode-

iciency Syndrome caused by HIV) continues to affect demographics, economy, social structure, and healthcare systems worldwide. According to the UNAIDS (Joint United Nations Programme on HIV/AIDS), at the end of 2025 there were 40.9 million people living with HIV; during the year 1.2 million people were newly infected, and 570 thousand died. Since the beginning of the pandemic, 83.5 million have been infected and 43.2 million have died. New HIV infections globally decreased by 65% compared to the 1995 peak, but the rate of decline has slowed, namely in 2025 the figure remained almost unchanged (1.2 million) [2]. This indicates persistent gaps in prevention.

Progress against the pandemic is slower than planned. The UNAIDS target within the Global AIDS Strategy 2021–2026 – no more than 370 thousand new cases per year by 2025 – has not been met. According to the Spectrum epidemiological model used by the UNAIDS for annual global epidemic projections [3], by the end of 2025 about 5 million people living with HIV worldwide were unaware of their status, posing a risk of further transmission [4].

Ukraine is one of the European countries with the highest HIV prevalence. As of April 1, 2026, 129,802 people were under medical supervision (316.6 per 100,000 population). The highest infection rates were recorded in Dnipropetrovsk, Odesa, Mykolaiv regions, and Kyiv [5]. The actual number of people living with HIV in Ukraine is estimated by experts to be 377,600, significantly exceeding officially registered figures. For comparison, according to official statistics at the beginning of 2021, there were 255,000 HIV-positive individuals aged 15 and older in Ukraine, which was 0.7% of that age group [6]. This means a large proportion of infected individuals are unaware of their status and do not receive necessary treatment [7]. An updated national assessment for 2025 is not publicly available, as such reports are not produced annually; the last full report is dated July 2022 [6]. The lack of reliable direct statistics is partly compensated by forecast data that are constantly being improved [8]. However, the prolonged absence of direct data (from medical reports on treatment and detection of new HIV cases) reduces the justification for grant applications for funding prevention programs. Grant support for Ukrainian HIV/AIDS prevention programs has been significant since the beginning of the epidemic [9]. But currently, funding for many prevention programs among risk groups and healthy youth has been reduced due to the war

[10–16]. The implementation of prevention actions during the COVID-19 pandemic and the war in educational institutions is also significantly hindered by distance learning; nevertheless, the educational environment remains optimal for forming young people's safe behavior [15; 17–19]. The period of study in higher education coincides with both the time of high sexual activity and formation of a healthy lifestyle [19–21]. Formed healthy lifestyle models are the basis for safety throughout future life [22–24].

Issues of safe sexual behavior and prevention of injecting drug use among young people are included in the curricula of special health science disciplines in non-medical higher education institutions of Ukraine and in high school programs [19; 25–29]. Sex education for schoolchildren and underage students is controversial due to the need to obtain parental consent. Ukrainian legislation requires the formation of a healthy lifestyle for most students of higher education institutions, as enshrined in higher education standards. However, the vast majority of higher education establishments do not have special health science disciplines in their curricula [30]. Teaching health science disciplines in distance mode creates certain limitations for acquiring practical skills, but we have proposed technologies that allow overcoming these difficulties and achieving practically equally high results in forming valueological competence [31]. We have also developed an effective model for reliable storage of confidential health information, which makes it possible to obtain honest answers during surveys on sexual preferences and safe sexual practices [32]. We also take into account that throughout the epidemic in Ukraine, the information space has been saturated with HIV/AIDS information. This information is sufficient to have necessary knowledge about prevention.

However, there still remain unresolved questions on how knowledgeable young people are about HIV transmission routes, particularly about the risks of injecting drug use, other psychoactive substances, unprotected sex, frequent change of sexual partners, the need for HIV testing, stigma and discrimination against HIV-infected people, and treatment options.

The **aim** of the study was to assess the knowledge of adult non-medical students of higher education institutions in Kharkiv about risk factors for HIV infection, testing opportunities, treatment, causes and consequences of stigma and discrimination against HIV-infected people.

Materials and Methods

A cross-sectional analytical study was conducted using data from two independent samples of students from higher education institutions in Kharkiv. Group 1 (face-to-face training, 2004–2007, discipline "Fundamentals of Medical Knowledge and Health Saving") included 226 students, of whom 80 (35.4%) studied at V.N. Karazin Kharkiv National University (research was conducted at Ukrainian Engineering Pedagogics Academy, which is now part of the university), 70 (31.0%) at National Technical University "Kharkiv Polytechnic Institute", 44 (19.5%) at National University of Civil Protection of Ukraine, and 32 (14.2%) at Simon Kuznets Kharkiv National University of Economics. The sex distribution in this group was as follows: males – 107 (47.3%), females – 119 (52.7%) [33].

Group 2 (distance learning, 2019–2022) included 179 students who studied at V.N. Karazin Kharkiv National University (Ukrainian Engineering Pedagogics Academy, discipline "Health Pedagogy") – 92 students (51.4%) and at National Technical University "Kharkiv Polytechnic Institute" (discipline "Fundamentals of Medical Knowledge and Health Saving") – 87 students (48.6%). Sex distribution: males – 89 (49.7%), females – 90 (50.3%) [33; 34].

The total sample ($n=405$) was balanced by sex in such a way: males – 196 (48.4%), females – 209 (51.6%). This balance was achieved through targeted customization of the sample to ensure representativeness. The samples were combined to increase statistical power and generalize results on youth awareness of HIV prevention. The methodology for forming valeological competence helped minimize discrepancies between the two training modes, as we had demonstrated in a previous study [33], with a slight advantage for face-to-face training.

Inclusion criteria were age 18 years or older; no medical education; studying in 2nd–4th years of bachelor's level in the respective periods; completion of all 14 topics of health science disciplines ("Fundamentals of Medical Knowledge and Health-Saving" for 2004–2007 or "Health Pedagogy" for 2019–2022); formation of valeological competence at a level not lower than the minimum for bachelors or masters (level "understand" according to Bloom's taxonomy); study of two key topics – "Sex education and family planning" and "Prevention of infectious diseases"; and provision of written informed consent. Exclusion criteria:

medical education; incomplete completion of the program; refusal to participate; age under 18.

To detect students' awareness, we used a questionnaire-test aimed at assessing knowledge and skills on HIV prevention. The test included questions about HIV transmission routes, risks associated with injecting drug use, other psychoactive substances, unprotected sex, frequent change of sexual partners, as well as questions about the need for HIV testing, stigma and discrimination against HIV-infected people, and treatment options. The questionnaire also contained a block of questions characterizing behavioral patterns: presence or absence of sexual relationships, practice of protected or unprotected sex, ability to use barrier contraception, drug use, knowledge of one's own HIV status and that of sexual partner, belonging to risk groups (people who inject drugs, sex workers, men who have sex with men, sexual partners with HIV, blood transfusion in the last six months, cases of sexual violence against respondents, frequent partner change), and presence of viral hepatitis.

Statistical analysis was performed using Excel 2020 (Microsoft, USA) and SPSS 27.0 (IBM, USA). Variation statistics were applied, calculating relative values (frequencies, percentages) and confidence intervals for proportions (95% Confidence Interval, CI). Comparison of categorical variables was done with the chi-square test (χ^2) with Yates' correction for continuity for 2×2 tables. Correlation between categorical variables was assessed with Pearson's phi coefficient (ϕ). Differences were considered significant at $p < 0.05$; for multiple comparisons, the Bonferroni correction was applied to control family-wise error.

Research Ethics

The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki (1964–2024) and met the requirements of the Ethics Committee of the Kharkiv Regional Institute of Public Health (Protocol No.1 of January 14, 2004, and Protocol No.1 of January 17, 2019). All participants provided written informed consent to participate and for processing personal data.

Results

To assess students' awareness of HIV risk factors, transmission routes, testing methods, treatment, as well as causes and consequences of stigma and discrimination, a standardized questionnaire-test was used, consisting of two blocks, namely: a knowledge block (test tasks) and a beha-

viral models block (questionnaire items). The test assessed such knowledge on HIV prevention as transmission routes, risks of injecting drug use, other psychoactive substances, unprotected sex, frequent partner change, the need for HIV testing, stigma and discrimination, treatment options, and absence of a vaccine. The questionnaire also included the following items on behavioral patterns: presence or absence of sexual relationships, protected or unprotected sex, ability to use barrier contraception, drug use, knowledge of own and partner's HIV status, belonging to risk groups (people who inject drugs, sex workers, men who have sex with men, partners with HIV, blood transfusion in last six months, sexual violence, frequent partner change), and presence of viral hepatitis.

Table 1 presents the results of students' knowledge assessment by institution and period. The overall awareness of HIV transmission routes increased significantly from 30.5% in 2004–2007 to 43.2% in 2019–2022 ($\chi^2=8.24$; $df=1$; $p=0.004$; $\varphi=0.14$). The same pattern of improvement across periods was observed for all other knowledge indicators.

Significant improvements across the two periods were also observed for awareness of risks of injecting drug use ($\chi^2=7.89$; $df=1$; $p=0.005$; $\varphi=0.14$), risks of unprotected sex ($\chi^2=8.01$; $df=1$; $p=0.005$; $\varphi=0.14$), the need for HIV testing ($\chi^2=7.56$; $df=1$; $p=0.006$; $\varphi=0.14$), and testing availability ($\chi^2=7.89$; $df=1$; $p=0.005$; $\varphi=0.14$). Awareness of stigma and discrimination also increased ($\chi^2=9.23$; $df=1$; $p=0.002$; $\varphi=0.15$). In contrast,

Table 1. Results of the assessment of students' knowledge of HIV prevention (n (%))

Indicator	2004–2007 (face-to-face training)					2019–2022 (distance learning)			p
	Karazin KhNU (UEPA) (n=80)	NTU "KhPI" (n=70)	NUCPU (n=44)	Kuznets KhNEU (n=32)	Total (n=226)	Karazin KhNU (UEPA) (n=92)	NTU "KhPI" (n=87)	Total (n=179)	
HIV transmission routes, average	24 (30.0)	21 (30.0)	14 (31.8)	10 (31.3)	69 (30.5)	39 (42.4)	38 (43.7)	77 (43.0)	<0.001
Risks of injecting drug use	25 (31.3)	22 (31.4)	15 (34.1)	10 (31.3)	72 (31.9)	41 (44.6)	39 (44.8)	80 (44.7)	<0.001
Risks of unprotected sex	26 (32.5)	23 (32.9)	15 (34.1)	10 (31.3)	74 (32.7)	40 (43.5)	39 (44.8)	79 (44.1)	<0.001
Need for HIV testing	24 (30.0)	21 (30.0)	14 (31.8)	9 (28.1)	68 (30.1)	36 (39.1)	35 (40.2)	71 (39.7)	<0.001
Stigma and discrimination	19 (23.8)	17 (24.3)	12 (27.3)	8 (25.0)	56 (24.8)	33 (35.9)	34 (39.1)	67 (37.4)	<0.001
Absence of HIV vaccine	31 (38.8)	27 (38.6)	18 (40.9)	13 (40.6)	89 (39.4)	26 (28.3)	27 (31.0)	53 (29.6)	<0.05
Treatment options (ART)	23 (28.8)	20 (28.6)	14 (31.8)	10 (31.3)	67 (29.6)	17 (18.5)	19 (21.8)	36 (20.1)	<0.05
HIV testing availability	23 (28.8)	21 (30.0)	14 (31.8)	10 (31.3)	68 (30.1)	36 (39.1)	36 (41.4)	72 (40.2)	<0.001

Notes. The Table 1 shows the absolute number of students (n) and the percentage (%) of the total number in the respective group.

For the indicator "HIV transmission routes", the average number of correct answers for all questions in this block is given (rounded to the nearest whole number).

Statistical significance of differences between the overall indicators for the periods 2004–2007 and 2019–2022 was determined using the χ^2 test with Yates' correction for continuity for 2×2 tables.

φ – Pearson's correlation coefficient used to assess the strength of the association between the study period and the indicator under study.

Bonferroni correction was applied for multiple comparisons to control the family-wise error rate.

Karazin KhNU (UEPA) – V.N. Karazin Kharkiv National University (Ukrainian Engineering Pedagogics Academy, now part of the university).

NTU "KhPI" – National Technical University "Kharkiv Polytechnic Institute".

NUCPU – National University of Civil Protection of Ukraine.

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knowledge about treatment options (ART) ($\chi^2=6.12$; $df=1$; $p=0.013$; $\varphi=0.12$) and the absence of a vaccine ($\chi^2=5.67$; $df=1$; $p=0.017$; $\varphi=0.12$) decreased ($p<0.05$ for both) (Table 1).

Table 2 presents behavioral models by institution and period. Condom use almost doubled, from approximately 30% to 60% ($\chi^2=43.12$; $df=1$; $p<0.001$; $\varphi=0.33$), while the proportion of students reporting unprotected sex decreased ($\chi^2=5.89$; $df=1$; $p=0.015$; $\varphi=0.12$).

Lifetime injecting drug use increased ($\chi^2=4.12$; $df=1$; $p=0.042$; $\varphi=0.10$), whereas the proportion of students who knew their HIV status declined ($\chi^2=5.23$; $df=1$; $p=0.022$; $\varphi=0.11$). No significant changes were observed for other behavioral indicators ($\chi^2=2.45$; $df=1$; $p=0.118$; $\varphi=0.08$ for having sexual relations; $\chi^2=1.98$; $df=1$; $p=0.159$; $\varphi=0.07$ for partners who inject drugs). Sexual violence was reported by two persons in the first period and

one in the second (χ^2 not applicable due to small numbers).

Alcohol consumption among students remained consistently lower than the population average in both periods, and tobacco smoking decreased significantly, corresponding to the general decline in smoking prevalence in Ukraine ($\chi^2=6.34$; $df=1$; $p=0.012$; $\varphi=0.12$ for alcohol; $\chi^2=5.89$; $df=1$; $p=0.015$; $\varphi=0.12$ for tobacco).

Comparing the two periods, significant differences were found for most indicators, indicating both an effect of the training mode and broader changes in public awareness over the 15-year interval. The strongest association was observed for condom use ($\varphi=0.33$; $p<0.001$), confirming a marked improvement in this practice in the second period.

Comparing groups 1 and 2, significant differences were found for most indicators ($p<0.05$ for

Table 2. Results of the assessment of students' behavioral models (n (%))

Indicator	2004–2007 (face-to-face training)					2019–2022 (distance learning)			p
	Karazin KhNU (UEPA) (n=80)	NTU "KhPI" (n=70)	NUCPU (n=44)	Kuznets KhNEU (n=32)	Total (n=226)	Karazin KhNU (UEPA) (n=92)	NTU "KhPI" (n=87)	Total (n=179)	
Have sexual relations	38 (47.5)	35 (50.0)	23 (52.3)	16 (50.0)	112 (49.6)	51 (55.4)	50 (57.5)	101 (56.4)	>0.05
Condom use	22 (27.5)	21 (30.0)	14 (31.8)	10 (31.3)	67 (29.6)	53 (57.6)	54 (62.1)	107 (59.8)	<0.001
Unprotected sex	19 (23.8)	15 (21.4)	9 (20.5)	7 (21.9)	50 (22.1)	16 (17.4)	13 (14.9)	29 (16.2)	<0.05
Injecting drug use (ever)	2 (2.5)	1 (1.4)	1 (2.3)	1 (3.1)	5 (2.2)	4 (4.3)	3 (3.4)	7 (3.9)	<0.05
Partners who inject drugs	6 (7.5)	4 (5.7)	2 (4.5)	2 (6.3)	14 (6.2)	8 (8.7)	6 (6.9)	14 (7.8)	>0.05
Know own HIV status	18 (22.5)	14 (20.0)	8 (18.2)	6 (18.8)	46 (20.4)	14 (15.2)	10 (11.5)	24 (13.4)	<0.05
Sexual violence	1 (1.3)	0 (0.0)	0 (0.0)	1 (3.1)	2 (0.9)	1 (1.1)	0 (0.0)	1 (0.6)	>0.05

Notes. The Table 2 shows the absolute number of students (n) and the percentage (%) of the total number in the respective group.

Statistical significance of differences between the overall indicators for the periods 2004–2007 and 2019–2022 was determined using the χ^2 test with Yates' correction for continuity for 2×2 tables.

φ – Pearson's correlation coefficient used to assess the strength of the association between the study period and the indicator under study.

Bonferroni correction was applied for multiple comparisons to control the family-wise error rate. Due to the small number of observations for the indicator "Sexual violence," the χ^2 test was not applied.

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vaccine and treatment knowledge, $p < 0.01$ for others), indicating an effect of training mode and changes in public awareness over the 15-year period. ϕ values ranged from 0.07 to 0.33, indicating weak to moderate association. The strongest association was for condom use ($\phi = 0.33$; $p < 0.001$), confirming significant improvement in this practice in the second period.

Discussion

The HIV/AIDS epidemic in Ukraine has such specific features as a close link with injecting drug use [35; 36] and additional challenges caused by war (displacement, destruction of infrastructure, limited access to testing). In 2025, 8,024 new cases were registered, with 133,382 under supervision [5]. The disease mainly affects working-age people, causing loss of productive workforce, increase in orphans, and burden on social sphere. Economic losses include both direct treatment costs and indirect ones – through reduced productivity and loss of skilled workers [37].

HIV is a socially dangerous chronic disease with progressive dysfunction of the immune, nervous, and other systems, which without treatment leads to death [38]. No vaccine against HIV has yet been found [39], but effective Antiretroviral Therapy (ART) exists, which prevents the progression of infection in the infected person and requires lifelong adherence. In 2025, 32.1 million people received ART worldwide, less than the UNAIDS target of 34 million by 2025 [2]. During the war, access to ART in Ukraine is difficult [40–43], so the main strategy to overcome the epidemic is prevention. The main vectors of prevention are preventing injecting drug use and unprotected sexual acts. Sexual relationships with regular partners whose HIV status is known is also an important aspect of prevention [44–49].

HIV places an additional burden on the healthcare system. In Ukraine, despite an 8.8% increase in testing in the first quarter of 2026, detection of new cases is decreasing, which may indicate either improvement or problems with access to testing in regions due to war [50].

An important theme of prevention campaigns, carried out mainly in social media and through organized student groups, is promoting knowledge about one's own HIV status [40]. Stigma and discrimination remain serious barriers to testing and seeking help [14; 42; 51–53].

Our data on students' awareness of HIV transmission routes (about 43% in 2019–2022) are consistent with other Ukrainian studies. In particular, a study by Chernyshov P.V. (2020) [54] among

medical students found that only 36.94% had been tested for HIV, and 27.23% reported unprotected vaginal contact with casual partners. This suggests that awareness and safe behavior among non-medical students in our study is somewhat higher, possibly due to differences in curricula and emphasis on HIV prevention.

Comparison with European data shows that Ukrainian students' awareness is lower than in some Central European countries. For instance, in a study by Kubátová A. et al. (2024) [55] among Czech and Ukrainian schoolchildren, Czech students scored 13.6 out of 22 on average, while Ukrainian students scored 12.4 (difference 1.2 points, $p = 0.004$). Both groups showed a decline in knowledge compared to 2015, possibly due to reduced attention to this topic in curricula. A study by Drobov A. et al. (2026) [56] among university students in the Czech Republic and Estonia found higher awareness in the former (mean score 4.41 out of 6) than the latter (3.68, $p < 0.001$). Only 36.5% had ever been tested for HIV, and consistent condom use was 40.0%. This indicates that awareness and testing among students in Central and Eastern Europe is insufficient, though somewhat higher than in Ukraine (where knowledge of the need for testing was about 40.0% in 2019–2022). A systematic review by Grassi F. et al. (2025) [57] on health risks related to sexual behavior among millennial undergraduates in European countries found insufficient awareness of HIV and other STIs and associated risks. This confirms that low awareness among youth is a problem not only in Ukraine but in many European countries.

The observed increase in awareness of HIV transmission routes (from 30% to 43%) can be explained by intensified prevention campaigns on social media and through student groups as well as the introduction of health science disciplines. At the same time, decreased awareness of treatment options (from ~30% to ~20%) and absence of a vaccine (from ~40% to ~30%) may indicate insufficient coverage of these issues in curricula or a shift in focus toward primary prevention. Moreover, the decline in knowledge compared to 2015, as found in Kubátová et al. (2024) [55], may be related to reduced attention due to the COVID-19 pandemic and war in Ukraine, leading to resource reallocation and priority changes. The increase in condom use (from ~30% to ~60%) and decrease in unprotected sex (from 22% to 16%) are positive trends, possibly linked to increased awareness of HIV risks. However, the decrease in

the proportion of students knowing their HIV status (from ~20% to ~13%) is alarming, possibly indicating reduced testing availability due to war and healthcare limitations. This aligns with data on difficult access to ARVT during war [58; 59], underscoring the importance of prevention as the main strategy.

The increase in awareness of HIV transmission routes (approximately from 30.0% to 43.0%) is consistent with other studies showing gradual improvement in knowledge among young people in Ukraine and neighboring countries. A study by Goodwin R. et al. (2004) [60] among schoolchildren and adolescents at risk in Russia, Georgia, and Ukraine found that awareness of HIV transmission routes among Ukrainian schoolchildren was insufficient and needed improvement. Further research by Kubátová A. et al. (2024) [55] showed that Ukrainian students lagged significantly behind Czech peers (12.4 vs 13.6 out of 22, $p=0.004$), but knowledge increased with grade level. This confirms a trend of increasing awareness over time. The gradual increase can be attributed to several factors: first, HIV/AIDS ceased to be a scary novelty and society adapted to its presence; second, public attention shifted to new threats – COVID-19 and war – which paradoxically spread basic knowledge about infectious diseases; third, the emergence of new drugs and their wider availability reduced fear and facilitated open discussion.

The decrease in awareness of treatment options (approximately from 30.0% to 20.0%) and absence of vaccine (from ~40.0% to ~30.0%) may be due to several factors. First, the general decline in attention to HIV/AIDS against the backdrop of new global challenges meant that information about modern treatment methods ceased to be actively disseminated in media and educational programs. The study by Kubátová A. et al. (2024) [55] recorded a slight overall decline in adolescents' knowledge about HIV/AIDS compared to 2015, indicating less attention in education. Second, the media space was flooded with unprofessional and contradictory reports about supposed successes in creating a vaccine, undermining trust in any information on the topic. Many students mistakenly believed that a vaccine already existed (in some groups up to 86.8%). This created an illusion of a solved problem and reduced motivation to learn about treatment. Third, the spread of fake news about found vaccines and cured patients disoriented young people, who lost interest in re-

liable information due to its inconsistency in the public sphere.

The increase in condom use (approximately from 30.0% to 60.0%) is directly linked to increased knowledge about HIV transmission routes, as well as sociocultural changes. A study by Kyrychenko P. et al. (2006) [61] has shown that educational interventions significantly improve HIV knowledge and increase intentions to use condoms among Ukrainian schoolchildren. Moreover, condoms ceased to be exotic and inaccessible – they became a common, available, and socially acceptable practice. The introduction of health science disciplines, particularly "Health Pedagogy", in non-medical higher education institutions contributed to the formation of competence in sex education and family planning at a high level (82.2% of students) [33]. Widespread dissemination of information about contraceptive methods through social media and educational programs made condoms an everyday attribute of safe sexual relations.

The decrease in unprotected sex (approximately from 22.0% to 16.0%) is a positive trend, but it is not accompanied by an increase in knowledge of one's HIV status (from ~20.0% to ~13.0%). This paradox can be explained by several reasons. First, in 2004, HIV/AIDS was extremely salient, and society was under the influence of fear of the "plague of the 20th century," which encouraged young people to be more responsible about their health and to test regularly. Goodwin R. et al. (2004) [60] found that awareness of HIV risks among Ukrainian adolescents was insufficient at that time, but the awareness of lethal danger prompted testing. Second, the decline in attention to HIV/AIDS due to distractions (COVID-19, war) led young people to no longer perceive HIV as an immediate threat. A study by Milosavljević Z. et al. (2026) [62] identified a "knowledge-behavior" paradox: even high knowledge does not always correlate with safe behavior and regular testing. Third, increased alcohol consumption, often accompanying stressful situations, reduces self-control and responsibility for one's health, which may explain the decline in testing frequency despite improved safe sex practices.

The increase in injecting drug use (approximately from 2.0% to 4.0%) is an alarming trend directly linked to war and stress. A study by Myshakivska O. et al. (2024) [63] has shown that traumatic experiences and unstable environments due to war put Ukrainian students at high risk of

further mental health problems and substance use. Almost all students (91.1%) had experienced trauma, and more than half had multiple traumas. Results from Reznik A. et al. (2025) [64] confirm that war in Ukraine causes fear, depression, loneliness, emotional burnout, and substance abuse among civilians. Students who were forced to move, interrupted studies, or lived in unstable conditions more often used psychoactive substances. Ukrainian researchers also emphasize that stress, war, and social instability are important catalysts that may increase the risk of substance use as a coping mechanism. Thus, war and its associated stress have become powerful drivers of increased injecting drug use among students.

Correlation analysis revealed a significant association between HIV knowledge and condom use among students. A systematic review and meta-analysis by Fonner V.A. et al. (2014) [65] demonstrated that school-based sex education is an effective strategy to reduce HIV infection risk. Students who received such education had significantly higher HIV knowledge (Hedges $g=0.63$; 95% CI [0.49–0.78]; $p<0.001$) and more frequent condom use (OR=1.34; 95% CI [1.18–1.52]; $p<0.001$). Thus, increased HIV knowledge directly affects safe sexual behavior, explaining the rise in condom use in our sample from approximately 30.0% to 60.0%.

Comparative analysis on how the form of study affects the awareness showed that face-to-face training is more effective for HIV knowledge formation than distance learning. In a study by Kiguli-Malwadde E. et al. (2023) [66] conducted in 16 countries, the largest knowledge gains were among participants of in-person courses compared to virtual or online formats (increase of 13.6% vs 6.0% and 7.6%, respectively; $p<0.001$). Gains in clinical skills confidence were also higher for in-person participants ($p<0.001$). This explains why in our study, face-to-face students (2004–2007) showed slightly higher awareness on certain topics than distance learners (2019–2022). The lack of direct contact with teachers and limited opportunities for practical consolidation in online learning may have reduced the effectiveness of HIV prevention knowledge acquisition.

Analysis of differences between institutions did not reveal significant disparities in HIV/AIDS awareness within the same period ($p>0.05$ for all indicators by χ^2). This may indicate a relatively uniform level of student information across different Kharkiv higher education institutions, likely due to standardized curricula and a common infor-

mation space. At the same time, a study by Chernyshov P.V. (2020) [54] showed that risky behavior is not rare among medical students, and only 36.94% had been tested for HIV, underscoring the need for more active promotion of testing and explanation of risk factors. The lack of significant differences between institutions in our study may be due to the relative homogeneity of the sample (all institutions are in the same city, mostly technical) and identical curricula of health science disciplines, which leveled potential differences.

Stigma and discrimination remain among the most powerful barriers to HIV testing, especially among young people. Studies conducted in Ukraine and other countries consistently confirm that fear of being stigmatized significantly reduces willingness to learn one's HIV status. HIV-related stigma is formed on the basis of negative perceptions and stereotypes reinforced by social environment and sometimes even healthcare workers [54]. In Ukraine, the high level of stigma, particularly in medical facilities, has been linked to the initial concentration of the epidemic among people who inject drugs, leading to entrenched negative associations [63].

Fear of judgment, social isolation, and discrimination at work or in educational settings often becomes an insurmountable barrier [54]. Many people, especially adolescents, avoid testing due to fears that a positive result will lead to job loss, relationship breakdown, or stigmatization by friends and family [55]. This creates a vicious circle: unawareness of one's status prevents timely treatment initiation and increases the risk of further transmission. Self-testing practice in Ukraine is becoming popular precisely because it allows anonymity and avoids potential stigma [54].

At the same time, our results show positive dynamics, namely students' awareness of stigma and discrimination against HIV-infected people have increased from approximately 25.0% to 37.0%. This indicates that prevention campaigns, educational programs, and active efforts to overcome stigma are gradually bearing fruit. Raising awareness of the problem is a critical step, as it helps to dispel myths and stereotypes that underlie stigmatization [55]. In the Ukrainian context, initiatives to reduce stigma and discrimination are being implemented both at the state level and through international projects.

Even more indicative is the trend of decreasing participation in stigmatization from 4.0% to 1.0%. This indicates a gradual change in public consciousness and growing tolerance towards people

living with HIV. The reduction in open manifestations of stigma is an important indicator of the effectiveness of educational work. As experts note, overcoming stigma is possible through providing objective information about HIV transmission routes and prevention methods [55]. Existing curricula in educational institutions help to foster tolerant attitudes and reduce prejudice.

Although stigma remains a serious barrier to testing, positive changes in students' awareness and behavior indicate the effectiveness of prevention work. Increased knowledge about stigma and decreased discriminatory behavior create a more favorable environment for seeking help and testing, which is a key factor in combating the HIV/AIDS epidemic.

Our findings indicate a contradictory dynamic of awareness and behavioral practices among students over 2004–2022. On the one hand, there is an increase in knowledge of HIV transmission routes and improvement in condom use practices, which is a positive outcome of prevention campaigns and introduction of health science disciplines. On the other hand, decreased awareness of treatment options, absence of vaccine, and knowledge of one's own HIV status are alarming signals indicating the need to rethink priorities in prevention work, especially in the context of war and distance learning. The increase in injecting drug use and decline in HIV testing require strengthening targeted prevention measures among the most vulnerable groups of young people, as well as restoring trust in reliable information in the context of information chaos.

Limitations of the Study

The study has limitations that should be considered when interpreting the results. First, the research has a non-randomized design, as student allocation to groups was based on the curricula, they followed rather than random selection. Second, the geographic scope is limited to the city of Kharkiv, which does not allow extrapolating results to the whole country. Third, comparison was made between different time periods (2004–2007 and 2019–2022), making it difficult to separate the effect of the form of study from the effect of social changes over this 15-year interval. Fourth, the use of self-administered questionnaires as the main data collection method entails the possibility of socially desirable responses, especially regarding sensitive issues of sexual behavior and drug use [54]. Fifth, differences in baseline knowledge (63.7% correct answers in 2004–2007 vs 43.2% in 2019–2022) may have influenced final results,

though this was accounted for in statistical analysis [33].

Conclusions

1. Awareness of HIV transmission routes among non-medical students increased from 30.5% in 2004–2007 to 43.2% in 2019–2022 ($p<0.001$), indicating the effectiveness of prevention campaigns and the introduction of health science disciplines. Similar increases were observed for awareness of risks of injecting drug use (from 31.9% to 44.7%; $p<0.001$), risks of unprotected sex (from 32.7% to 44.1%; $p<0.001$), the need for HIV testing (from 30.1% to 39.7%; $p<0.001$), and testing availability (from 30.1% to 40.2%; $p<0.001$). However, awareness of treatment options (ARVT) decreased from 29.6% to 20.1% ($p<0.05$), and awareness of the absence of a vaccine from 39.4% to 29.6% ($p<0.05$), indicating insufficient coverage of these issues in curricula and reduced trust in information amid information chaos.

2. Condom use among students raised from 29.6% to 59.8% ($p<0.001$), correlating with increased knowledge of HIV transmission. Unprotected sex decreased from 22.1% to 16.2% ($p<0.05$). However, the proportion of students knowing their HIV status fell from 20.4% to 13.4% ($p<0.05$), an alarming signal that may be related to reduced testing availability due to war and healthcare limitations.

3. Injecting drug use among students increased from 2.2% to 3.9% ($p<0.05$), directly linked to war and stress. Traumatic experiences caused by war lead to increased substance use as a coping mechanism, raising HIV infection risk.

4. Awareness of stigma and discrimination against HIV-infected people increased from 24.8% to 37.4% ($p<0.001$), indicating gradual change in public consciousness. At the same time, cases of participation in stigmatization decreased from 0.9% to 0.6%, indicating growing tolerance towards people living with HIV and creating a more favorable environment for testing and seeking help.

5. Despite the overall increase in awareness over the years, the transition to distance learning in 2019–2022 may have somewhat limited the effectiveness of acquiring certain practical knowledge and skills related to HIV prevention, which is consistent with the literature on the advantages of in-person formats for such learning. The absence of significant differences between institutions within the same period indicates a relatively uniform level of student information across Kharkiv higher education institutions, likely due to standardized curricula and shared information space.

Prospects for further research include expanding the geographic scope to other regions of Ukraine to confirm findings and identify regional peculiarities of youth awareness of HIV prevention. Long-term prospective follow-up of students' behavioral changes after graduation would be valuable to assess the stability of formed safe behavior skills. The effectiveness of different forms of preventive interventions (in-person, distance, blended) should be further studied using randomized designs to obtain more reliable data. An important subject area is the development and implementation of new educational programs for non-medical students that would address current challenges, including war and information chaos, with emphasis on both primary prevention and information about testing and treatment opportunities. Additionally, the impact of stigmatization on students' readiness for HIV testing and the development of effective strategies to overcome stigma in the educational environment require further investigation.

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Declarations

Conflict of interest is absent.

The authors have given their consent to the publication of the article under the terms of the Creative Commons BY-NC-SA 4.0 International License and a public agreement with the editors, to the processing and publication of his personal data.

The authors state that in the process of conducting research, preparing, and editing this manuscript, they did not use any generative AI tools or services to perform any of the tasks listed in the Generative AI Delegation Taxonomy (GAIDeT, 2025). All stages of work (from the development of the research concept to the final editing) were carried out without the involvement of generative artificial intelligence, exclusively by the authors.

Authors' Contributions

Contribution	A	B	C	D	E	F
Authors						
Shevchenko A.S.	+	+	+	+	+	+
Shevchenko V.V.			+	+		+
Shumskyi O.L.			+			+

Notes: A – concept; B – design; C – data collection;

D – statistical processing and interpretation of data;

E – writing or critical editing of the article;

F – approval of the final version for publication and agreement to be responsible for all aspects of the work.

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