

Monitoring excess mortality among people with diagnosed HIV in Poland (2012–2024): insights from national claims data

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Abstract

Background

Evidence on mortality trends among people with diagnosed HIV (PHIV-D) in Central European region is limited. We aimed to compare the mortality rates between general and HIV positive population and investigate the trends during 2012–2024 in Poland.

Methods

In this database study on the in the public payer, National Health Fund, claims data linked with census registry we applied an algorithm to identify PHIV-D, relying on the number of HIV-related and other claims. We estimated per year: number of PHIV-D aged 18+, mortality rate and standardized mortality ratio (SMR) for general population comparison. Kaplan-Meier estimator and Cox proportional hazard model reporting adjusted hazard ratios (HR) were used for overall survival among newly diagnosed.

Results

PHIV-D population increased from 8.1 thousands in 2012 to 18.6 thousands in 2024, with proportion of females decreasing from 25% to 19%. In 2012–2024 there were 16,040 new diagnoses and 2621 deaths among adults aged 18 and older. The total number of deaths recorded in 18–64 age group was 2,386 and the mortality in this group decreased from 2.66% in 2012 to 1.47% in 2024, and SMR, with respect to general population of comparable age, decreased from 18.2 to 8.8 in females and from 6.6 to 3.4 in males. Survival increased significantly with year of diagnosis and was lower in case of AIDS at diagnosis (HR 4.21, 95% CI 3.79–4.69) and during COVID-19 pandemic (HR 1.22, 95% CI 0.99–1.50) vs before pandemic.

Conclusion

The PHIV-D, in particular women with HIV, are at much higher risk of death than the general population. This difference is relatively large as compared to studies in other countries, which could be partially explained by frequent late presentation.

Introduction

HIV mortality rates are declining. In European Union / European Economic Area member states the registered death rate fell by 47% between 2013 and 2024 [1] and globally, the UNAIDS estimates that the number of AIDS-related deaths decreased by 54%, from approximately 1.4 million in 2010 to 630,000 in 2024, which is attributable to improved access to treatment [2]. Moreover, the ongoing improvement in terms of HIV-related mortality could result from developments in antiviral therapy regimen with introduction of more potent, safer and easier to use drug classes and formulations, often characterised by higher genetic barrier as well [3]. Important changes were implemented in the treatment initiation policy within the last decade. Before 2015, treatment was reserved to people with CD4 cell counts below certain thresholds. This was subsequently expanded to all HIV patients [4], following the research demonstrating detrimental effects of treatment deferral [5]. This policy was adopted in Poland in 2016 [6]. Importantly, antiretroviral treatment in Poland since 2001 is part of a dedicated governmental program, to warrant antiretroviral therapy irrespective of insurance status.

Despite the improvements, the mortality among people with diagnosed HIV infection (PHIV-D) in many countries [7] has been reported to exceed the mortality in general population. Factors that specifically impact on worse survival include late presentation. It has been observed that people who have higher CD4 and started treatment after introduction of highly active antiretroviral therapy (after 2015 year) have not much lower life expectancy compared to the general population, but unfortunately, this is not the case for individuals diagnosed with CD4 count below 350 cells/ mm³ [8]. In addition, research shows that the burden of late presentation remains high in the Europe, and especially in the Eastern European countries, leading to high number of new AIDS events and deaths [9]. Data from COHERE and EuroSIDA cohorts indicate that 48.4% of cases were classified as late presenters in 2020 – 2016 ranging from 36.9% in Estonia and Ukraine to 64.2% in Poland [9]. A more recent study in Poland (2016–2017) found that 44.8% of individuals presented late to HIV clinics [10]. Late presentation to HIV clinics may be due to late diagnosis or delayed linkage to care. A study of individuals diagnosed in voluntary testing facilities in central Poland in 2010–2013 showed that 20% were not linked to care in 3 years follow-up [11]. Late presentation tends to be significantly more frequent among women, one study found even a 6-fold difference [12].

Evidence is also accumulating that aging PHIV-D suffer more often from comorbidities than general population [13, 14] and they are also at increased risk of transitioning to frailty [15], suggesting premature aging. In effect, they may be at increased risk of adverse health outcomes

and earlier death [16]. The data on mortality in PHIV-D from Central Europe, including Poland, are limited. The mortality rates are known to be severely underestimated in surveillance data, with Statistics Poland reporting approximately 100 deaths due to HIV (ICD-10 codes B20 – B24) annually, 10 times more than registered in surveillance data [17]. On the other hand, we note that the mortality among PHIV-D cannot be monitored solely based on the census statistics as deaths due to causes of deaths unrelated to HIV infection are increasing frequent in this group. In European and North American cohort the proportion of deaths due to AIDS declined from 49% during 1996-99 to 16% in 2016-20 [18], although higher AIDS-related mortality is observed in Eastern Europe as compared to other European regions [19].

We therefore aimed to develop methodology to monitor trends in mortality rates of PHIV-D in Poland in comparison to the general population. Conceptually, we intended to make use of routinely available data to complement the ongoing case-based reporting surveillance efforts. We describe the trends in the mortality rates among people who live with HIV in Poland, in 2012–2024 and analyse demographic factors related to poor survival.

Methods

Study design and data sources

We conducted an observational cohort study based on the National Health Fund (NHF) data related to visits in outpatient care and hospitalizations (service data) as well as drugs purchased in pharmacies (prescriptions data). NHF is the single public payer in Poland financing public health services based on universal national insurance. We selected service and prescription data referring to the entire population of adults (aged 18 years or more at the reception of the service) in 2012–2024. Service data comprise ICD-10 code of primary and co-existing conditions, for which the service was sought. The condition codes are not available in the prescriptions data. NHF routinely and on an ongoing basis imports the data on deaths from the national census database.

Information on gender, age divided into 6 groups (18–24; 25–34; 35–44; 45–54; 55–64; 65+), residence type (rural, urban < 100,000, 100,000–500,000 and > 500,000 inhabitants), date of first service with HIV-related ICD-10 code and date of death was extracted for each individual classified as HIV positive (see definitions below). All individual level information was processed by the NHF team and only fully anonymised, aggregated data released for analysis.

General population mortality rates were used for comparisons and calculations of standardized mortality ratios and the source of the parameters was the Statistics Poland.

Important covariates were not available from the NHF database, these included: CD4 count at diagnosis, HIV transmission category or country of birth.

Definitions

We used a previously described definition for PHIV-D [20]. A person was assigned to the population PHIV-D based on service data when used at least 2 services financed by the NHF, the main or co-occurring cause of which was related to HIV infection, i.e. ICD-10 codes B.20-B.23 with extensions and B.24, Z21, F02.4, R.75 (Additional file 1, Table A1). Patients with a single HIV-related hospitalization, which ended in patient's death, were also included. The date of the first service of the above was considered the date of diagnosis of HIV infection.

The number of people diagnosed with HIV that currently live in Poland excludes people with no registered service or reimbursed prescription (i.e. based on both service and prescription data), regardless of the cause, in the consecutive 24 months. We assume those people left the country, permanently or temporarily. If another visit is registered after the break, the person is re-included in the study population.

War refugees from Ukraine were also excluded from the analysed PHIV-D population, defined as people with Ukrainian citizenship or using health services financed by the NHF under the *Act of on assistance to citizens of Ukraine in connection with an armed conflict on the territory of this country*, for whom the first HIV-related service was registered no earlier than in February 2022.

AIDS at HIV diagnosis was defined as meeting at least one of the following criteria :

(1) hospitalization of at least 5 days with an AIDS-defining condition (list of ICD-10 code related to AIDS indicative disease in Additional file 1, Table A1) occurring no earlier than 6 months before and no later than 6 months after the first HIV-related service; (2) at least one reimbursed prescription for co-trimoxazole (Biseptol/Bactrim) dispensed within 6 months after the first HIV-related service; or (3) an AIDS-defining ICD-10 code (Table A1) recorded no earlier than 6 months before and no later than 1 month after the first HIV-related service.

Data Analysis

Data analysis was performed in 3 steps: 1) descriptive analysis (all PHIV-D aged 18+); 2) mortality analysis (PHIV-D aged 18–64); 3) survival analysis (PHIV-D diagnosed in 2012–2024, aged 18 + at diagnosis).

For the mortality analyses, we restricted the PHIV-D and general population to individuals aged 18–64. The upper age limit was introduced as the individuals aged over 64 constitute a very small proportion of Polish PHIV-D population and they are on average younger than general population aged over 64. Mortality rate in an year was calculated as the ratio of the annual number of deaths divided by the population size as of June 30 of the respective year. Mortality in PHIV-D is shown as crude rates and as the rates standardized to the age and gender distribution of PHIV-D in 2012. The general population mortality rates were standardized to age and gender distribution of PHIV-D, by year. The Standardized Mortality Ratio (SMR) was calculated separately for females and males as the ratio of observed deaths in PHIV-D to expected deaths derived from age-specific general population mortality rates applied to the PHIV-D age distribution. 95% confidence intervals were calculated using the chi-squared approximation method, implemented in R base.

For the survival analysis the inclusion criteria encompassed individuals diagnosed between 2012–2024, with an age of at least 18 years at the time of diagnosis. The Cox proportional hazard model aimed to evaluate the impact of several covariates on the time from HIV diagnosis to death, including sex, age (time varying), residence type, year of diagnosis, AIDS at diagnosis, and the presence of the Covid-19 pandemic (time varying: before/during/after). Individuals whose death was not recorded by the end of the observation period or who were considered to have emigrated were right-censored. The results of Cox proportional hazard model were reported as uni- and multivariable hazard ratio (HR) with 95% confidence interval (CI). A p-value of < 0.05 was considered as statistically significant.

The analysis was performed with R statistical software (R version 4.2.3) with use of *survival*, *ggsurvfit*, *gtsummary* packages.

Results

1. Patient characteristics

In 2024, there were 18.6 thousand people (aged 18 and above) with diagnosed HIV living in Poland, which is more than twice as many as in 2012 (8.1 thousand, Additional file 1, Figure A1). The predominant group among PHIV-D population is men. The proportion of women has gradually declined over the analyzed years, from 25% in 2012 to 19% in 2024. The largest age group among both genders is individuals aged 35-44. The PHIV-D aged 45 of more constituted 24% of females and 28% of men in 2012. This proportion increased respectively to 53% and 41% in 2024 (Additional file 1, Figure A2).

2. Overall mortality trends

Overall 2,621 deaths of adult PHIV-D, including 2,386 at the age 64 or less, were noted in 2012-2024. A notable decline of crude mortality rate can be observed from 2015 to 2018, followed by stabilization (Figure 1). During the Covid-19 pandemic, mortality increased, reaching 1.71% in 2021, and then decreased again to 1.49% in 2022. Comparison to the mortality rates in PHIV-D population standardized to age and gender distribution of PHIV-D in 2012 indicates that the course of the mortality curve in PLDH population is partly influenced by the aging process. In 2024, the difference between the crude and standardised to 2012 population mortality rates was 0.23%.

The standardized mortality ratio (SMR) comparing PHIV-D to general population decreased from 7.8 in 2012 to 3.9 in 2024 overall. Examining SMR by sex, in 2012, the SMR comparing PHIV-D to general population among females was 18.2, nearly three times higher than among males (Table 1.). SMR declined substantially over the study period in both sexes, from 18.2 (95% CI: 13.5-24.0) in 2012 to 8.8 (95% CI: 6.6-11.6) in 2024 in females, and from 6.6 (95% CI: 5.7-7.7) to 3.4 (95% CI: 2.9-3.9) in males. In males, SMR stabilized from 2021 onwards, consistently remaining between 3.2 and 3.4. In females, however, the trend was less stable, with SMR fluctuating in recent years - declining to 7.1 (95% CI: 5.1-9.6) in 2023 before rising to 8.8 (95% CI: 6.6-11.6) in 2024.

Table 1. Mortality rates per 100K people aged 18-64 among people with diagnosed HIV (PHIV-D) compared to the general population, Poland 2012-2024

	Females			Males		
	PHIV-D ^(a)	general population standardized to age distribution of PHIV-D	SMR ^(b) (95% CI)	PHIV-D ^(a)	general population standardized to age distribution of PHIV-D	SMR ^(b) (95% CI)
2012	2 504	137	18,2 (13,5-24,0)	2 713	411	6,6 (5,7-7,7)
2013	2 096	141	14,9 (10,8-20,0)	2 474	404	6,1 (5,2-7,1)
2014	2 225	143	15,6 (11,5-20,6)	2 613	390	6,7 (5,8-7,7)
2015	1 828	147	12,5 (9,0-16,8)	2 376	399	6,0 (5,1-6,9)
2016	1 466	154	9,5 (6,6-13,2)	2 063	394	5,2 (4,5-6,1)
2017	1 355	159	8,5 (5,9-11,9)	1 791	394	4,6 (3,9-5,3)
2018	1 189	167	7,1 (4,8-10,1)	1 708	412	4,2 (3,6-4,8)
2019	1 685	170	9,9 (7,3-13,2)	1 569	415	3,8 (3,2-4,4)
2020	1 431	190	7,5 (5,4-10,2)	1 728	471	3,7 (3,2-4,2)
2021	1 640	219	7,5 (5,6-9,9)	1 724	523	3,3 (2,9-3,8)
2022	1 465	193	7,6 (5,6-10,1)	1 500	468	3,2 (2,8-3,7)
2023	1 285	182	7,1 (5,1-9,6)	1 464	427	3,4 (3,0-3,9)
2024	1 598	181	8,8 (6,6-11,6)	1 437	425	3,4 (2,9-3,9)

(a) PHIV-D - people with diagnosed HIV

(b) SMR - standardized mortality ratio

3. Characteristics of newly diagnosed HIV cases 2012-2024

Between 2012 and 2024, 16,040 individuals aged 18 and above were diagnosed with HIV, resulting in an average annual rate of 39.5 cases per 1 million (Table 2). Of these diagnoses, 13,512 (84.2%) were among males, and 11,238 (70.1%) occurred in individuals aged 25 to 44 years.

Table 2. Characteristics of newly diagnosed HIV cases, Poland, 2012 – 2024

		Number of new diagnoses	%	Average annual incidence per 1 million
Total		16 040	100.0%	39.5
Sex	Females	2 528	15.8%	11.9
	Males	13 512	84.2%	69.7
Age at diagnosis	18-24	1 822	11.4%	48.2
	25-34	6 321	39.4%	87.8
	35-44	4 917	30.7%	63.1
	45-54	2 014	12.6%	31.1
	55-64	650	4.1%	9.8
	65+	316	2.0%	3.7
Residence type	City > 500K	5 170	32.2%	89.4
	City 100K-500K	3 325	20.7%	39.9
	City ≤ 100K residents	4 113	25.6%	26.0
	Rural	2 979	18.6%	15.0
	NA	453	2.8%	-
Year of diagnosis	2012-2013	2 209	13.8%	35.1 ^(a)
	2014-2015	2 230	13.9%	35.4 ^(a)
	2016-2017	2 498	15.6%	39.6 ^(a)
	2018-2019	2 518	15.7%	40.0 ^(a)
	2020-2021	2 626	16.4%	42.2 ^(a)
	2022-2023	2 630	16.4%	42.7 ^(a)
	2024	1 329	8.3%	43.2 ^(a)
AIDS at diagnosis	Yes	4 551	28.4%	12.0
	No	11 489	71.6%	27.5

(a) Average annual incidence per 1M in given period

Regarding the distribution of individuals diagnosed with HIV across different residence types, 2,979 (18.6%) resided in rural area, 4,113 (25.6%) lived in cities with populations up to 100 thousands, 3,325 (20.7%) were from cities with populations ranging from 100 to 500 thousands, and 5,170 (32.2%) were from cities with populations exceeding 500 thousands.

4. Overall survival among people with HIV

A total of 16,040 PHIV-D were included in the survival analyses, of whom 1,559 individuals (9.7%) died during the observation period. The probability of surviving the first year after diagnosis for the total group was 0.954, while for 5-years since diagnosis it was 0.913 (Table 3.). According to the Cox analysis the risk of death was significantly higher with older age and among individuals in small towns with populations up to 100 thousands. Moreover, being diagnosed after 2015 was significantly associated with a reduced risk of death (Table 3, Figure 2). Figure 2. demonstrates a gradual improvement in survival probabilities across successive diagnostic periods from 2012–2014 to 2015 and further to 2016–2019. This positive trend was disrupted during the pandemic years (2020–2022), when survival probabilities declined, particularly in the first months after diagnosis. However, survival outcomes improved again in 2023–2024, approaching the levels observed before the pandemic. Additionally, in the multivariate model the risk of death was higher during COVID-19 pandemic (HR=1.22, 95% CI: 0.99-1.50), irrespective of the diagnosis date (Table 3), although this effect did not reach statistical significance. Finally, individuals with AIDS at HIV diagnosis were found to be at significantly higher risk of death (HR=4.21, 95% CI:3.79-4.69).

Discussion

We report a national level analysis of the mortality in the cohort of individuals diagnosed with HIV and living in Poland in 2012–2024. For this purpose we focused on development of novel methodology that would allow continuous monitoring of the indicator, based on reimbursement claims data. The algorithm to establish the PHIV-D cohort takes into account longitudinal data on health services reported to the single public payer, the NHF. NHF has an estimated coverage of 91% population, with most of the uninsured living abroad but remaining registered as residents [21]. Further, the database integration with the national census database allows to monitor both the mortality rates and the number of people with HIV, who are alive.

We found that the overall mortality of PHIV-D in Poland is still markedly higher than in the background population. The SMR exceeded 7 among women and 3 among men even in the most recent years. High SMRs, of similar order of magnitude, with respect to general population, were also reported by other researchers [22, 23], although direct comparison is complicated by different time periods of analysis. One study from US, found SMR for HIV infected individuals entering care in 2011–2017 of 2.12, which is markedly lower than our estimates [24]. In addition, the all-cause mortality noted in European and North American cohorts, amounted in 2016–2020 to 7.9 per 1000 person-years [18]. To some extent the individuals followed-up in cohort studies are the ones with better prognosis [25], still this rate is substantially lower as compared to our finding of the annual mortality rates of approximately 1.6% (corresponding to 16 per 1000 person-years) during the same time. Given that survival depends strongly on the initial CD4 count [8], late presentation may explain this difference. Our analysis confirms that being diagnosed with AIDS defining disease at initial HIV diagnosis was associated with over 4-fold higher risk of death (HR 4.21). We note that concurrent HIV/AIDS diagnosis was present in just over one-quarter of cases (28.4%). We analysed AIDS at diagnosis instead of late presentation due to the availability of data, but AIDS at diagnosis indicates usually severe immunodeficiency and thus encompasses only a small fraction of late presenters as defined by the consensus definition [26]. Prior clinical review studies indicate that over a half of HIV diagnoses in Poland are late presenters [9, 27–29], with possible implications for survival rates.

The mortality rate reported in our study displayed a decreasing trend in 2015–2017. This decrease coincides with the developments in the treatment initiation policy, from the policy based on the CD4 count < 350 cells/mm³ in 2013 and earlier, through the threshold of < 500 cells/mm³ in 2014–2015 to the policy to treat everyone irrespective of CD4 count, which was introduced in Poland in 2016 [6]. Interestingly, the trend in the mortality rate levelled in 2018–2019, the reason for which remains unclear. The cohort of PHIV-D is an ageing cohort with 43% of individuals aged 45 years or more in 2024 as compared to only 27% in 2012. By calculating the mortality rate standardized to the age distribution in 2012 we were able to demonstrate that to some extent aging of the PHIV-D cohort slows down the improvement in mortality rates. Aging HIV-infected individuals were found to be disproportionately affected by age-related conditions, possibly due to the infection itself, effects of prolonged exposure to antiretroviral treatment or lifestyle factors [30, 31]. In consequence, deaths due to cardiovascular disease, non-AIDS cancer and liver diseases are on the rise [18, 32, 33], which can contribute to slowing down the improvement in mortality rates. It is also possible that the flattening of the trend reflects the trends in overall mortality rates in Poland that were found to be reversed even before the COVID-19 pandemic [34].

We noted the evident COVID-19 pandemic - related increase in mortality, similar among men and women in general population and in HIV positive population. Detailed survival analysis demonstrated that the hazard of death during the 2020–2022 was 22% higher (HR 1.22) irrespective of the time of HIV diagnosis. High excess mortality in Poland during the pandemic is well-documented [34] and looking at SMR during this time we observe that it is comparable to the previous years' indicating similar impact of the pandemic on mortality among PHIV-D and on the mortality in general population. On the other hand, although being diagnosed in 2020–2022 was not associated with lower survival, a tendency for higher mortality was noticeable during the first several months after the diagnosis. This could be caused by delayed diagnosis related to disturbances in the testing systems during the lock-downs [35] or prolonged time between diagnosis and linkage to HIV care [36].

In our study sex was not significantly associated with increased overall mortality, although the survival tended to be lower among men in Cox proportional hazard analysis (HR 1.15, p-value 0.039). This is in line with the prior research reporting only slightly worse life expectancy among men than among women (9), but in contrast to the general population, where women have markedly lower mortality rates than men. In consequence, the excess mortality in women with HIV is higher than among men with HIV. Focusing in 2024, we noted SMR of 8.8 among women and 3.4 among men with HIV as compared to the general population. Most of previous studies' findings are similar, for example studies in Korea [37], Spain [23] or USA [38] all found higher excess mortality among women with HIV. These differences were attributed to sex differences in lifestyle factors related also to HIV transmission risk, as well as stigma and mental health issues influencing health – related decisions, impacting treatment adherence [23, 39, 40]. In addition, higher rate of late diagnosis among women may play role, and it was indeed confirmed in other Polish studies [10, 12, 27] that late diagnosis is more common among women.

The strength of our study is the inclusion of the national cohort linked to the census database. This allows to monitor time changes and demographic variability of indicators such as mortality rates with consistent methodology. At the same time it is worth to mention that the analysis was performed only based on the aggregated data provided by the National Health Fund analytic team. Thus our analysis is a proof

of concept for increasing the use of Electronic Health Records and claims data for infectious diseases surveillance in Poland, with due respect to data privacy.

Our study has several limitations. Firstly, we based our analysis on the algorithm for HIV case identification in the administrative claims data, which we were not able to validate on the basis of individual data. However, we run extensive sensitivity analysis for the variants of definitions and validated it against national surveillance data [20]. The finally adopted definition is well aligned with other validated definitions [41, 42]. We view the cohort identified in the National Health Fund as relatively comprehensive, despite the nominal coverage of NHF insurance of 91%. Even though there could be a subgroup of PHIV-D who were not insured based on employment or self-employment, usually they could obtain insurance through welfare mechanisms and the antiretroviral therapy is funded separately through a Ministry of Health program [43]. Even if the most precarious and vulnerable individuals are not registered with the NHF, this likely underestimates the mortality in the PLHIV-D group to a higher degree than in the general population, thus the excess mortality could be even higher than indicated by our results. Secondly, the results of HIV-specific laboratory studies were not available, including CD4 count. We were therefore not able to fully analyse the impact of late presentation and given our results this would be crucial for understanding the inequalities in survival, often related to the status at diagnosis. By nature the claims data do not give access neither to clinical data such as adherence to treatment nor to behavioural data, but they can generate important hypotheses that can be explored in focused studies. Moreover, we were not able to study the effect of comorbidities as there was no available algorithms to define these in the reimbursement data. Further work would be needed to take into account the relative impact of co-existing conditions on the observed mortality in the PHIV-D cohort. Finally, we excluded the refugees from Ukraine in 2022 from our analysis to present the background situation and trends before the war. However, we have to acknowledge the challenges that provision of care to the refugees is presenting to the HIV care system in Poland and changes to the epidemic characteristics that are likely to take place in effect of the migration wave in the future [44].

In conclusion, the trend in all-cause mortality among PHIV-D is beneficial, although the PHIV-D, and in particular women with HIV are still at much higher risk of death than the general population. This difference is relatively large as compared to studies in other countries. Late presentation may be one of the driving causes of this situation.

Table 3. Factors related to overall survival in PHIV diagnosed in 2012-2024

		Total [N]	Dead [N]	%1- year survival	%5- years survival	Univariable HR (95%CI)	p- value	Multivariable HR (95%CI)	p- value
Total		16 040	1559	0.954	0.913	-	-	-	-
Sex	Female	2 528	257	0.952	0.912	-	-	-	-
	Male	13 512	1302	0.954	0.913	0.96 (0.84-1.10)	0.6	1.15 (1.01-1.32)	0.039*
Age at diagnosis	18-24	1 822	56	0.992	0.976				
	25-34	6 321	380	0.975	0.949				
	35-44	4 917	549	0.943	0.898				
	45-54	2 014	344	0.912	0.840				
	55-64	650	128	0.900	0.812				
	65+	316	102	0.860	0.726				
Age (time varying covariate)	18-24					-	-	-	-
	25-34					2.42 (1.58-3.71)	<0.001*	2.04 (1.33-3.12)	0.001*
	35-44					5.12 (3.37-7.78)	<0.001*	3.73 (2.45-5.67)	<0.001*
	45-54					8.58 (5.62-13.1)	<0.001*	5.49 (3.59-8.38)	<0.001*
	55-64					10.9 (7.04-16.9)	<0.001*	6.69 (4.31-10.4)	<0.001*
	65+					16.0 (10.2-25.0)	<0.001*	11.9 (7.62-18.7)	<0.001*
Residence type	over 500K	5 170	335	0.972	0.945	-	-	-	-
	100K-500K	3 325	335	0.950	0.909	1.62 (1.39-1.89)	<0.001*	1.33 (1.14-1.55)	<0.001*
	up to 100K residents	4 113	556	0.937	0.88	2.20 (1.92-2.52)	<0.001*	1.79 (1.56-2.05)	<0.001*
	village	2 979	316	0.948	0.903	1.76 (1.51-2.05)	<0.001*	1.49 (1.28-1.74)	<0.001*
	NA	453	17	0.963	0.96	0.84 (0.52-1.37)	0.5		0.3
Year of diagnosis	2012	1038	197	0.941	0.888	-	-	-	-
	2013	1171	201	0.942	0.887	0.97 (0.80-1.19)	0.8	1.04 (0.85-1.27)	0.7
	2014	1094	170	0.939	0.893	0.93 (0.75-1.14)	0.5	1.06 (0.85-1.31)	0.6
	2015	1136	156	0.953	0.904	0.85 (0.69-1.06)	0.2	0.96 (0.77-1.20)	0.7
	2016	1149	135	0.954	0.92	0.78 (0.62-0.97)	0.028*	0.87 (0.69-1.10)	0.2
	2017	1349	117	0.964	0.931	0.62 (0.49-0.79)	<0.001*	0.59 (0.45-0.75)	<0.001*
	2018	1177	100	0.967	0.921	0.67 (0.52-0.85)	0.001*	0.66 (0.50-0.87)	0.003*
	2019	1341	120	0.954	0.913	0.76 (0.60-0.96)	0.024*	0.73 (0.55-0.97)	0.028*
	2020	1180	74	0.959	-	0.58 (0.44-0.77)	<0.001*	0.63 (0.44-0.90)	0.012*
	2021	1446	103	0.951	-	0.75 (0.58-0.96)	0.022*	0.69 (0.48-0.99)	0.043*
	2022	1304	73	0.956	-	0.67 (0.50-0.88)	0.004*	0.60 (0.41-0.89)	0.01*
	2023	1326	62	0.961	-	0.65 (0.49-0.88)	0.005*	0.57 (0.36-0.90)	0.016*
	2024	1329	51	0.958	-	0.72 (0.52-0.99)	0.043*	0.66 (0.41-1.05)	0.081
AIDS at HIV diagnosis	No	11 489	545	0.990	0.962	-	-	-	-
	Yes	4 551	1014	0.863	0.792	5.09 (4.58-5.64)	<0.001*	4.21 (3.79-4.69)	<0.001*
C19 (time varying covariate)	before					-	-	-	-
	during					0.90 (0.79-1.01)	0.082	1.22 (0.99-1.50)	0.068

after

0.81 (0.70-0.93) 0.002* 1.20 (0.90-1.60) 0.2

*: Indicates p value <0.05

Abbreviations

CI
confidence interval
HR
hazard ratio
NHF
National Health Fund
PHIV
D—people with diagnosed HIV
SMR
standardized mortality ratio

Declarations

Ethics approval and consent to participate: The study was conducted in accordance with relevant provisions of the Declaration of Helsinki, respecting the European Union General Data Protection Regulation (GDPR) safeguards and derogations for processing of personal data for research use, in addition to the national legislation on secondary health data use (including the Act on Patients' Rights and the Patient Ombudsman). In particular, the data were processed only by a dedicated employee of the National Health Fund, in a secure internal environment, including only selected variables for data minimization. The data were anonymized and aggregated prior to release for analysis. The requirement for ethics approval and informed consent to participate was waived by the Ethical Committee of the National Institute of Public Health NIH – National Research Institute (**Komisja Bioetyczna Narodowego Instytutu Zdrowia Publicznego PZH Państwowego Instytutu Badawczego** <https://www.pzh.gov.pl/komisja-bioetyczna/>) (Opinion No. 2/2026).

Consent for publication: Not applicable

Availability of data and materials: Restrictions apply to the availability of this dataset. Dataset contains administrative health data which was obtained with the permission of Ministry of Health of the Republic of Poland from the National Health Fund (NFZ) electronic databases. The data are protected under the Protection of Privacy Act. Access to the data will require formal permission by the Data Stewards within the Ministry of Health.

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Figures

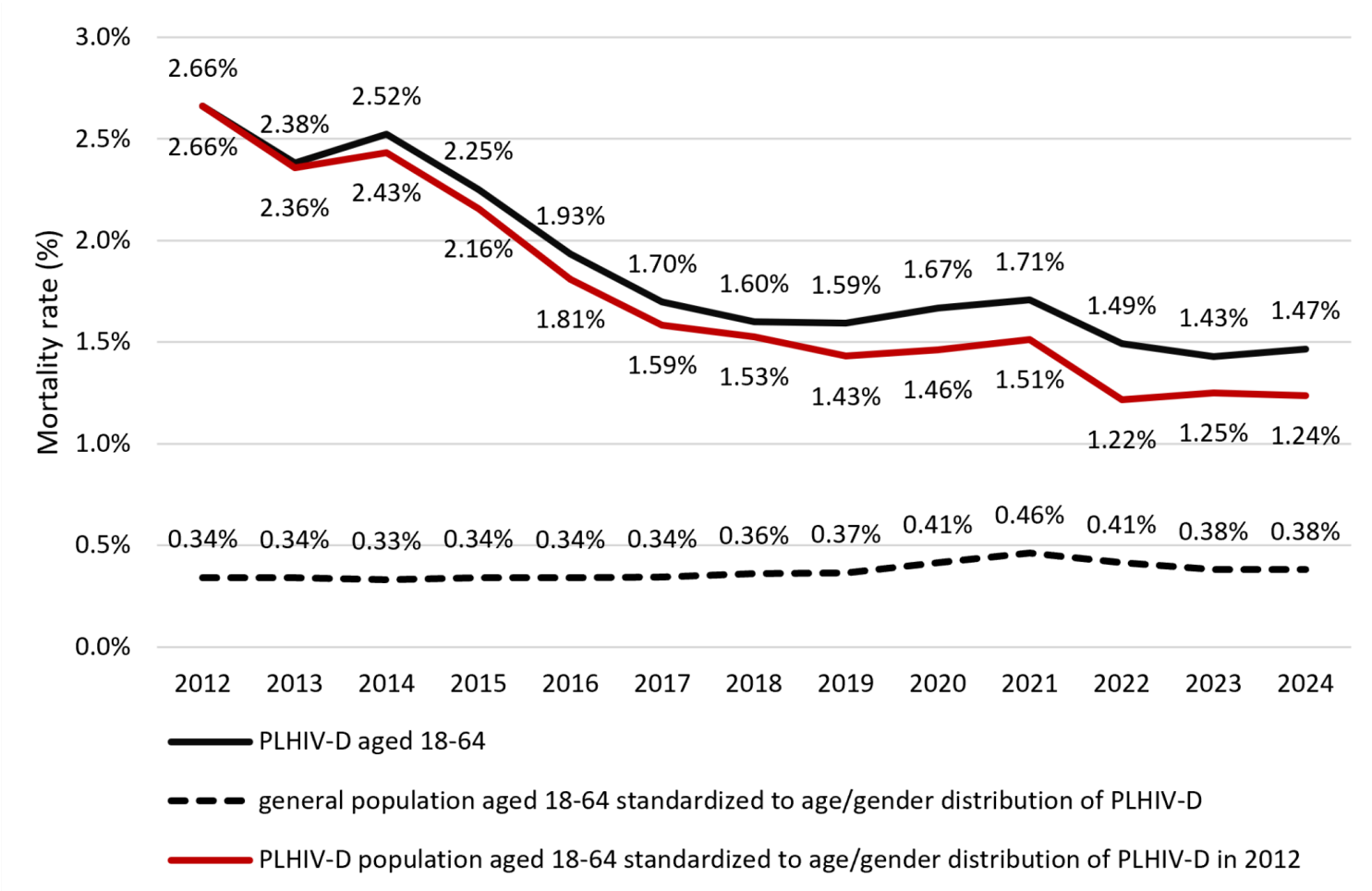


Figure 1

Overall crude and standardised mortality trends, Poland 2012-2024

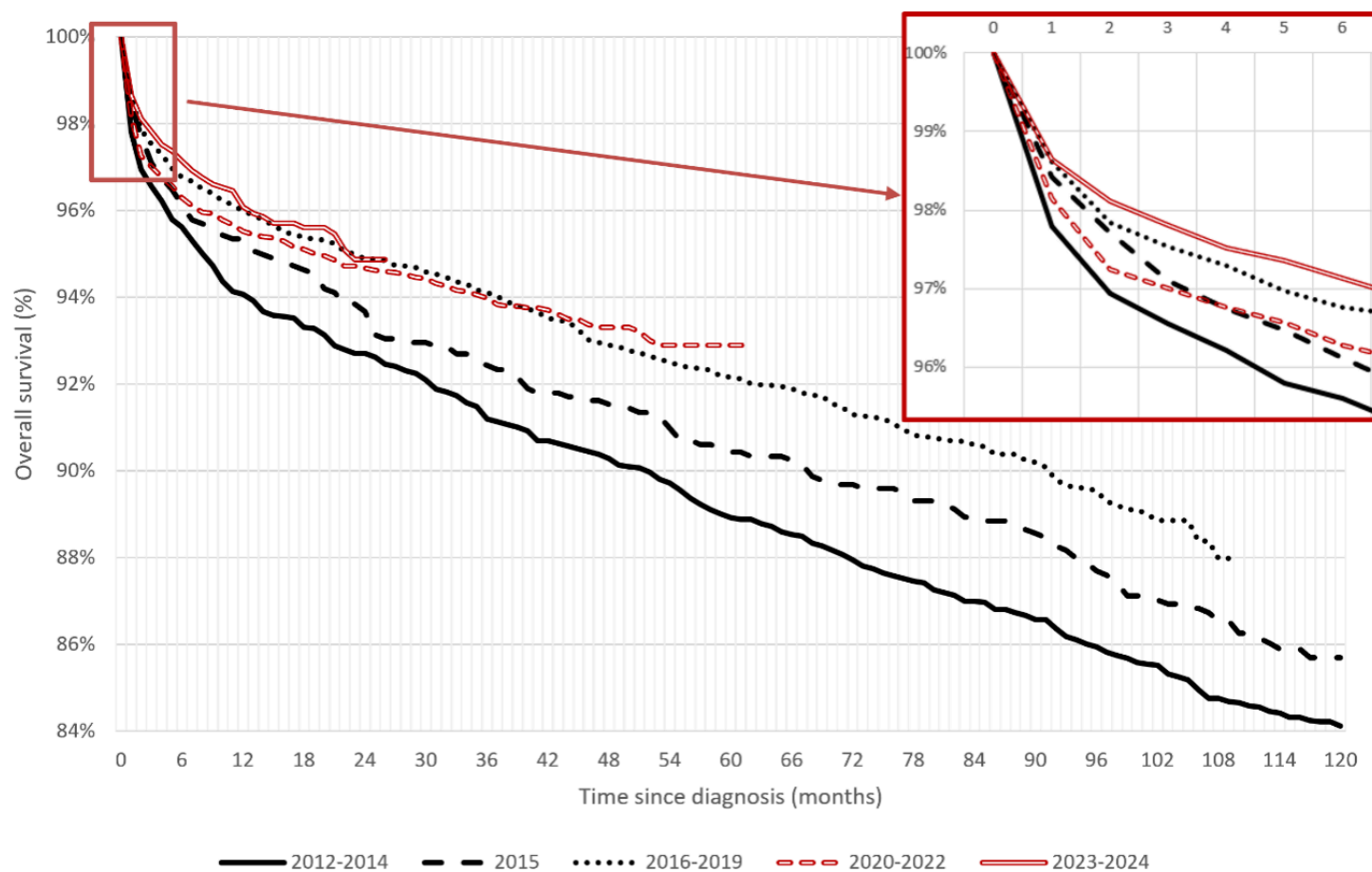


Figure 2

Overall survival probability among PHIV-D in Poland diagnosed in 2012-2022, by the year of diagnosis

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