

## Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

### Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
<input type="checkbox"/>	<input checked="" type="checkbox"/> The exact sample size ( $n$ ) for each experimental group/condition, given as a discrete number and unit of measurement
<input type="checkbox"/>	<input checked="" type="checkbox"/> A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
<input type="checkbox"/>	<input checked="" type="checkbox"/> The statistical test(s) used AND whether they are one- or two-sided <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
<input type="checkbox"/>	<input checked="" type="checkbox"/> A description of all covariates tested
<input type="checkbox"/>	<input checked="" type="checkbox"/> A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
<input type="checkbox"/>	<input checked="" type="checkbox"/> A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
<input checked="" type="checkbox"/>	<input type="checkbox"/> For null hypothesis testing, the test statistic (e.g. $F$ , $t$ , $r$ ) with confidence intervals, effect sizes, degrees of freedom and $P$ value noted <i>Give <math>P</math> values as exact values whenever suitable.</i>
<input checked="" type="checkbox"/>	<input type="checkbox"/> For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
<input checked="" type="checkbox"/>	<input type="checkbox"/> For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
<input checked="" type="checkbox"/>	<input type="checkbox"/> Estimates of effect sizes (e.g. Cohen's $d$ , Pearson's $r$ ), indicating how they were calculated

*Our web collection on [statistics for biologists](#) contains articles on many of the points above.*

### Software and code

Policy information about [availability of computer code](#)

Data collection	Data were extracted from electronic patient records by trained data collectors for ATHENA data. Data from Statistics Netherlands are registry based data. Statistics Netherlands (Centraal Bureau voor de Statistiek, CBS) is an independent organization that collects, processes and publishes reliable statistical data on residents of the Netherlands.
Data analysis	STATA (v16.0, StataCorp, College Station, TX, USA). All code underlying our analyses are available from: <a href="https://github.com/vitajongen/HIVcarecontinuum_NatureCommunications.git">https://github.com/vitajongen/HIVcarecontinuum_NatureCommunications.git</a>

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

## Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

All results presented here are calculated from non-public registry data from Centraal Bureau voor de Statistiek (CBS), accessed through the Remote Access environment. CBS was not involved in the calculation of any of the results presented. While the data are not publicly available, academic institutions can apply for access to the Remote Access environment through the CBS (for additional information, see <https://www.cbs.nl/en-gb/our-services/customised-services-microdata/microdata-conducting-your-own-research>).

ATHENA cohort data (without CBS data) used in this study are available upon reasonable request. Requests for data access can be made to: [hiv.monitoring@amsterdamumc.nl](mailto:hiv.monitoring@amsterdamumc.nl). Requests will be reviewed on a case-by-case basis. Statistical information or data for separate research purposes from the ATHENA cohort can be requested by submitting a research proposal to SHM (<https://www.hiv-monitoring.nl/english/research/research-projects/>). The proposal will undergo review by representatives of SHM for evaluation of scientific value, relevance of the study, design, and feasibility, statistical power, and overlap with existing projects.

## Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	Data on gender are collected, and together with sexual preference used to stratify analyses based on men who have sex with men, cis-gender heterosexual men, and cis-gender women. Transgender persons were excluded from analyses due to small numbers.
Reporting on race, ethnicity, or other socially relevant groupings	We used migration background in the analyses, which was categorized as no migration background, first generation migration background (individual and at least 1 parent born outside of the Netherlands) and second generation migration background (person born in the Netherlands, but at least 1 parent born outside of the Netherlands).
Population characteristics	Median age was 52 of the 21,788 included individuals. We included 13,668 men who have sex with men, 3,999 cis-gender heterosexual men and 4,121 women. 49.8% had no migration background, 42.0% a first generation migration background, and 8.2% a second generation migration background. Almost 27% had completed a college or university degree. 24% had an income below the poverty line and 12% had received social welfare in 2023.  Median age at HIV diagnosis was 35 and 76% was diagnosed before 2015.
Recruitment	People entering HIV care receive written material about participation in the ATHENA cohort, after which they are asked to consent verbally to the use of their routinely collected medical data for research and monitoring (i.e., an “opt-in” procedure).
Ethics oversight	Data collection was approved by boards of all participating centers

Note that full information on the approval of the study protocol must also be provided in the manuscript.

## Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☒ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://nature.com/documents/nr-reporting-summary-flat.pdf)

## Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	Quantitative study using data from an ongoing observational cohort study and registry data from Statistics Netherlands.
Research sample	30,730 individuals with HIV ever registered in the ATHENA cohort. Of them, data from 28,294 (92%) individuals were linked with data from Statistics Netherlands. Individuals who could not be combined were younger and more often born outside the Netherlands. They were also less often MSM and more often had a detectable viral load. As people are only represented in Statistics Netherlands if they have a postal code by the end of the calendar year, this may mean that the individuals who could not be combined represent a group of people with more intersecting vulnerabilities (e.g., undocumented migrants or homeless individuals).  Median age of individuals who could be linked was 52 (interquartile range 42-60), and 54% was born in the Netherlands. 59% of

	individuals were men who have sex with men and the majority of individuals was diagnosed with HIV <2015. The vast majority (94%) had an undetectable viral load at their last measurement.
Sampling strategy	ATHENA is a real-world cohort. As described above, all individuals initiating HIV care in the Netherlands are asked to participate in ATHENA.
Data collection	<p>At enrolment into the ATHENA cohort, the following demographic information was collected: year of birth, country of birth, sex assigned at birth, gender identity (if different from sex at birth), and most likely transmission route of HIV. Data from routine visits are extracted from patient records by trained data collectors or automatically (lab based data).</p> <p>Statistics Netherlands provided detailed individual-based socio-demographic and socio-economic information, including education level, migration background, employment status, household composition, household income, and use of social welfare. Details on which datasets were used from Statistics Netherlands can be found in Appendix A.</p>
Timing	Data collection for ATHENA started in 1998. For these analyses we used data from all individuals still in HIV care by 31 December 2023
Data exclusions	<p>We included all those who belonged to key populations with sufficient numbers of individuals for which the risk of identification was minimal (i.e., <math>n \geq 10</math>). This criterion resulted in the inclusion of men who have sex with men (MSM), other men, women, while those who were transgender could not be included. Individuals who were diagnosed with HIV-2, migrated outside of the Netherlands or were deceased before 31 December 2023 were also excluded from analysis. Of the 28,294 individuals who could be linked, 572 individuals had migrated or died by 2023 and were thus excluded from analysis. Additionally, we excluded individuals who were &lt;18 years of age (<math>n=107</math>), had HIV-2 (<math>n=164</math>), were transgender (<math>n=331</math>), had not been in care for over 10 years (<math>n=23</math>), and had no data in 2023 (<math>n=5,309</math>).</p> <p>In total, 21,788 individuals with HIV were included in the analysis: 13,688 MSM, 3,999 cis-gender heterosexual men, and 4,121 women.</p>
Non-participation	People who retract their informed consent are immediately removed from ATHENA databases.
Randomization	No experimental groups

## Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

### Materials & experimental systems

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology and archaeology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input type="checkbox"/>	<input checked="" type="checkbox"/> Clinical data
<input checked="" type="checkbox"/>	<input type="checkbox"/> Dual use research of concern
<input checked="" type="checkbox"/>	<input type="checkbox"/> Plants

### Methods

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging

## Clinical data

Policy information about [clinical studies](#)

All manuscripts should comply with the ICMJE [guidelines for publication of clinical research](#) and a completed [CONSORT checklist](#) must be included with all submissions.

Clinical trial registration	This is not a clinical trial
Study protocol	The ATHENA cohort profile can be found here: Boender, T. S. et al. AIDS Therapy Evaluation in the Netherlands (ATHENA) national observational HIV cohort: cohort profile. BMJ Open 8, e022516 (2018). <a href="https://doi.org/10.1136/bmjopen-2018-022516">https://doi.org/10.1136/bmjopen-2018-022516</a>
Data collection	Data collection for ATHENA started in 1998 and is on-going. Data are collected at the centres where individuals are in HIV care.
Outcomes	Primary outcomes are: viral suppression (defined as a HIV-1 RNA <200 copies/mL) and engagement in care (defined as at least 1 HIV clinical care visit before 31 December 2023)

Plants

Seed stocks	NA
Novel plant genotypes	NA
Authentication	NA