

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

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☐ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☒ | ☐ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☒ | ☐ | 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> |
| ☒ | ☐ | A description of all covariates tested |
| ☒ | ☐ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ | 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) |
| ☒ | ☐ | 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 P values as exact values whenever suitable.</i> |
| ☒ | ☐ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ | 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	The datasets used were acquired from MassIVE (identifier MSV000083478), the PRoteomics IDentifications Database (PRIDE, identifier PXD029644) and from GlycoPOST (identifier GPST000356.0).
Data analysis	The N- and O-glycans analysis performed in this study can be replicated using GlycoGenius v. 1.2.8 (with GUI v. 1.0.7) and the GAGs analysis can be replicated on GlycoGenius v. 1.2.15 (with GUI v. 1.0.15). The GUI versions are available at https://github.com/LoponteHF/GlycoGenius_GUI/releases/ and the backend is available at https://github.com/LoponteHF/GlycoGenius or by installation through PyPI.

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 datasets converted to mzML format and GG results files generated during data analysis and presented in this work are available on Zenodo (<https://doi.org/10.5281/zenodo.14630509>).

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	This data is not relevant for the provided study.
Reporting on race, ethnicity, or other socially relevant groupings	This data is not relevant for the provided study.
Population characteristics	This data is not relevant for the provided study.
Recruitment	This data is not relevant for the provided study.
Ethics oversight	This data is not relevant for the provided study.

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://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Life sciences study design

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

Sample size	For the N-glycomics dataset, a n=3 was used (with extra samples used for specific figures), for O-glycomics dataset, n=19 and for the GAGs dataset, n=3. For details on where each sample data was used in the figures, check the table of contents on the data repository (https://zenodo.org/records/14630509)
Data exclusions	No data were excluded. All the datasets analyzed are comparable to the original articles datasets.
Replication	The N- and O-glycans analysis performed in this study can be replicated using GlycoGenius v. 1.2.8 (with GUI v. 1.0.7) and the GAGs analysis can be replicated on GlycoGenius v. 1.2.15 (with GUI v. 1.0.15). The GUI versions are available at https://github.com/LoponteHF/GlycoGenius_GUI/releases/ and the backend is available at https://github.com/LoponteHF/GlycoGenius or by installation through PyPI. Newer versions will always be available (with more features and/or improved analysis), but results may vary when compared to the presented results.
Randomization	The experimental groups replicate the original publications in order to keep comparable.
Blinding	Not relevant to the present study.

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
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Plants

Seed stocks	Not applicable for this study.
Novel plant genotypes	Not applicable for this study.
Authentication	Not applicable for this study.