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In the interest of transparency and to help readers form their own judgements of potential bias, Nature Portfolio journals require authors to declare any competing financial and/or non-financial interest in relation to the work described in the submitted manuscript.

Competing interests declaration

- ☒ We declare that none of the authors have competing financial or non-financial interests as defined by Nature Portfolio.
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Large Language Models (LLMs), such as ChatGPT, do not currently satisfy our authorship criteria. Notably an attribution of authorship carries with it accountability for the work, which cannot be effectively applied to LLMs. Use of an LLM should be properly documented in the Methods section (and if a Methods section is not available, in a suitable alternative part) of the manuscript.

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Policy information about Authorship: inclusion & ethics in global research

All authors are encouraged to provide an "Inclusion & Ethics" statement where relevant.

- ☒ We have provided an "Inclusion & Ethics" statement.

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Data availability statement

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- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
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- ☒ We have provided a full data availability statement in the manuscript.

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Confirm that all relevant data are deposited into a public repository and that accession codes are provided.

- ☐ All relevant accession codes are provided ☒ Accession codes will be available before publication ☐ No data with mandated deposition

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Code availability statement

For all studies using custom code or mathematical algorithm that is deemed central to the conclusions, the manuscript must include a statement under the heading "Code availability" describing how readers can access the code, including any access restrictions. Code availability statements should be provided as a separate section after the data availability statement but before the References.

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For all data presented in a plot, chart or other visual representation confirm that:

n/a | Confirmed

- ☐ ☒ Individual data points are shown when possible, and always for $n \leq 10$
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Does not apply

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- ☒ ☐ Macromolecular structural data
- ☒ ☐ Unique biological materials
- ☐ ☒ Research animals and/or animal-derived materials that require ethical approval
- ☒ ☐ Human embryos, gametes and/or stem cells
- ☒ ☐ Human research participants
- ☒ ☐ Clinical data
- ☒ ☐ Archaeological, geological, and palaeontological materials

Research animals

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research

Ethical compliance

☒ We have complied with all relevant ethical regulations and include a statement affirming this in the manuscript.

Ethics committee

☒ We have disclosed the name(s) of the board and institution that approved the study protocol in the manuscript.

I certify that all the above information is complete and correct.

Typed signature Jia Sun

Date Jun 24, 2026

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