nature portfolio

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Last updated by author(s): Mar 5, 2025

# 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<br>*Only common tests should be described solely by name; describe more complex techniques in the Methods section.* |
| ☐ | ☒ | 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<br>*Give P values as exact values whenever suitable.* |
| ☐ | ☒ | 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 | All fluorescent images were acquired using a Olympus FV3000 confocal fluorescent microscope system.<br>FITC-dextran concentration was determined using a microplate reader system (Tecan).<br>EM images were acquired using a JEM-1400PLUS electron microscope.<br>Fluorescent image-based quantification was conducted with Image J software.<br>Cytokines in medium were analyzed using a microplate reader system (Tecan). |
| Data analysis | Data were recorded using Excel (Microsoft) software. GraphPad Prism 8 software was used for statistical analysis. |

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

*Provide your data availability statement here.*

## 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 | No human participants, data, or biological material were included in the study. |
| Reporting on race, ethnicity, or other socially relevant groupings | No human participants, data, or biological material were included in the study. |
| Population characteristics | No human participants, data, or biological material were included in the study. |
| Recruitment | No human participants, data, or biological material were included in the study. |
| Ethics oversight | No human participants, data, or biological material were included in the 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

# Life sciences study design

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

| | |
|---|---|
| Sample size | In all experiments, at least three samples were included in a single experiment, each with at least three technical replicates. |
| Data exclusions | No data were excluded from the analyses. |
| Replication | All experiments have at least three technical replicates. |
| Randomization | Samples were randomly allocated into experimental groups. |
| Blinding | Investigators were blinded to group allocation during data collection and analysis. |

# 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 |
|---|---|
| [ ] | [x] Antibodies |
| [ ] | [x] Eukaryotic cell lines |
| [x] | [ ] Palaeontology and archaeology |
| [x] | [ ] Animals and other organisms |
| [x] | [ ] Clinical data |
| [x] | [ ] Dual use research of concern |
| [x] | [ ] Plants |

## Methods

| n/a | Involved in the study |
|---|---|
| [x] | [ ] ChIP-seq |
| [x] | [ ] Flow cytometry |
| [x] | [ ] MRI-based neuroimaging |

# Antibodies

Antibodies used

In immunofluorescence experiments, the primary antibodies below were used:
Anti-VE-cadherin antibody (Proteintech Group, 66804-1-Ig, 1:100), Anti-VE-cadherin antibody (Cell Signaling Technology, 2500S, 1:200), Anti-PECAM-1 antibody (HUABIO group, M1511-8, 1:200), Anti-Claudin-5 (ImmunoWay group, YT0952, 1:200), Anti-S100β antibody (Proteintech Group, 15146-1-AP, 1:200), Anti-S100β antibody (Proteintech Group, 66616-1-Ig, 1:100), Anti-GFAP antibody (Cell Signaling Technology, 3670S, 1:100), Anti-GFAP antibody (HUABIO group, EM140707, 1:200), Anti-Tuj-1 antibody (Cell signaling Technology, 5568S, 1:100), Anti-MAP2 antibody (Cell signaling Technology, 4542S, 1:100), Anti-IBA1 antibody (Abcam, Ab178847, 1:100), Anti-CD11b antibody (Abcam, ab52478, 1:100), Anti-CD11b antibody (Proteintech group, 66519-1-Ig, 1:100), Anti-CD68 antibody (Cell signaling Technology, 76437S; 1:200), Anti-CD19 antibody (Abcam, ab134114, 1:200), Anti-CD3 antibody (Abcam, ab135372, 1:200), Anti-CD45 antibody (Abcam, ab8216, 1:200), Anti-IBA1 (Proteintech Group, 66827-1-Ig, 1:100), Anti-IBA1 (Proteintech group, 10904-1-AP, 1:100), Anti-HSV-1 gG antibody (Santa Cruz, Sc-69804, 1:200), Anti-P62 antibody (Abcam, Ab280086, 1:200), Anti-LC3B antibody (Cell signaling Technology, 3868S, 1:200), Anti-ZO-1 antibody (Proteintech Group, 21773-1-AP, 1:200), Anti-Ki67 antibody (Abcam ab, 243878, 1:200), Anti-Aβ40 antibody (Bioss, bsm-0106M , 1:200), Anti-Aβ42 antibody (Cell Signaling Technology, 14974T, 1:200).

In immunofluorescence experiments, the secondary antibodies bellow were used:
Anti-mouse IgG conjugated with Alexa Fluor 488 (Abcam, ab150113, 1:500), Anti-rabbit IgG conjugated with Alexa Fluor 488 (Abcam, ab150077, 1:500), Anti-mouse IgG conjugated with Alexa Fluor 594 (Abcam, ab150116, 1:500) and Anti-rabbit IgG conjugated with Alexa Fluor 594 (Abcam, ab150080, 1:500).

Validation

All antibodies were obtained from commercial vendors. We relied on information provided in the corresponding Data Sheets provided by the manufacturers.

# Eukaryotic cell lines

Policy information about cell lines and Sex and Gender in Research

Cell line source(s)

HBMECs were purchased from ScienCell Corporation (no. 1000) . HA cells were purchased from ScienCell Corporation (no. 1800) . HMC3 cells were purchased from Procell Corporation (no. CL-0620). SH-SY5Y cells were purchased from Procell Corporation (no. CL-0620). Human peripheral blood mononuclear cells (PBMCs) were isolated from fresh human peripheral blood using Ficoll (GE Healthcare) density gradient centrifugation.

Authentication

All cells were cultured according to the instructions of suppliers. The cell-specific markers for HBMECs, HA cells and HMC3 cells have been examined by immunostaining.

Mycoplasma contamination

All cells were tested negative for mycoplasma contamination.

Commonly misidentified lines
(See ICLAC register)

None.

# Plants

Seed stocks

None.

Novel plant genotypes

None.

Authentication

None.