

## 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<br><i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> A description of all covariates tested   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons  |
| <input checked="" type="checkbox"/> | <input 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<br><i>Give <math>P</math> values as exact values whenever suitable.</i>                            |
| <input type="checkbox"/>            | <input checked="" 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** The length measurements—humerus, ulna/radius, metacarpal II (carpometacarpus for avialans), femur, tibia (tibiotarsus for avialans), and metatarsal III (tarsometatarsus for avialans) of Mesozoic theropodS—were obtained by direct measurement in combined with published source data

**Data analysis** Analyses of morphological disparity were conducted in R using relevant functions including phyl.resid, phyl.pca, adonis, gelman.diag and effectiveSize. Evolutionary rate analyses were performed using the BayesTraitsV4 (<http://www.evolution.rdg.ac.uk>).

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	Not applicable
Reporting on race, ethnicity, or other socially relevant groupings	Not applicable
Population characteristics	Not applicable
Recruitment	Not applicable
Ethics oversight	Not applicable

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)

## Ecological, evolutionary & environmental sciences study design

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

Study description	This study analyses the morphological disparity and evolutionary rate of limb bone size during the theropod-birds transition.
Research sample	To investigate changes of body shape close to the origin of the Avialae, we compiled linear measurements of limb bones across the whole spectrum of Mesozoic theropod phylogeny, including early diverging avialans. The length measurements—humerus, ulna/radius, metacarpal II (carpometacarpus for avialans), femur, tibia (tibiotarsus for avialans), and metatarsal III (tarsometatarsus for avialans)—were obtained by direct measurement in combined with published source data.
Sampling strategy	We compiled a large sample of Mesozoic theropod specimens that completely preserve the six appendicular limb elements.
Data collection	Linear measurements of limb bones across the whole spectrum of Mesozoic theropod phylogeny were obtained by direct measurement in combined with published source data by the corresponding author Min Wang.
Timing and spatial scale	The fossil samples span the whole spectrum of Mesozoic theropod phylogeny.
Data exclusions	We omitted specimens that do not preserve complete length for all six limb bones, given the controversy regarding scaling relationships of limb size.
Reproducibility	The R code is accessible at Figshare as well as OSF ( <a href="https://osf.io/8n3wt/?view_only=753148d6a15f478e8fa027890b6b9bde">https://osf.io/8n3wt/?view_only=753148d6a15f478e8fa027890b6b9bde</a> ), and can be used to reproduce the results presented in this manuscript.
Randomization	Not applicable
Blinding	Not applicable
Did the study involve field work?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

## 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 &amp; experimental systems

n/a	Involvement
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input type="checkbox"/>	<input checked="" type="checkbox"/> Palaeontology and archaeology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input checked="" type="checkbox"/>	<input 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	Involvement
<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

## Palaeontology and Archaeology

Specimen provenance

Linear measurements of limb bones across the whole spectrum of Mesozoic theropod phylogeny were obtained by direct measurement in combined with published source data. The raw data is available in the Supplementary information.

Specimen deposition

The R code, raw data, and results derived from the phylogeny scaled using the “equal” method are available at Figshare as well as OSF ([https://osf.io/8n3wt/?view\\_only=753148d6a15f478e8fa027890b6b9bde](https://osf.io/8n3wt/?view_only=753148d6a15f478e8fa027890b6b9bde)).

Dating methods

Not applicable

Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.

Ethics oversight

Institute of Vertebrate Paleontology and Paleoanthropology has approved the study protocol

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