

## GATHER checklist

*Manuscript: Evolving burden of falls and fall-related fractures in China, 1990-2023, with projections to 2035: GBD 2023 estimates and the individual-level cascade to disability in CHARLS*

Item wording is reproduced from the GATHER statement (Stevens GA, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. The Lancet 2016;388:e19-e23, doi:10.1016/S0140-6736(16)30388-9). GATHER applies to the GBD 2023 component (national modelled estimates, decomposition and projections); the CHARLS cohort component is reported under STROBE. Locations cite section headings and Tables/Figures; Additional file 1 tables are labelled S1-S5.

| Item                          | Recommendation (verbatim)                                                                                                                                                                                     | Location in this manuscript                                                                                                                                                                                                                                          |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Objectives and funding</b> |                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                      |
| 1                             | Define the indicator(s), populations (including age, sex, and geographic entities), and time period(s) for which estimates were made.                                                                         | Methods, Overall design and GBD 2023 source (six measures, twelve fracture sites, low-BMD attribution; mainland China, excluding HK/Macau/Taiwan; 1990-2023 with projection to 2035; age rules 0+ totals, 15+ curves, 45+ cross-database comparison).                |
| 2                             | List the funding sources for the work.                                                                                                                                                                        | Declarations, Funding (no specific grant from any sector).                                                                                                                                                                                                           |
| <b>Data inputs</b>            |                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                      |
| 3                             | Describe how the data were identified and how the data were accessed.                                                                                                                                         | Methods, GBD 2023 source (IHME GBD 2023 Results Tool, three custom China extractions); Declarations, Availability of data and materials; Zenodo archive carries the exact query download manifest.                                                                   |
| 4                             | Specify the inclusion and exclusion criteria. Identify all ad-hoc exclusions.                                                                                                                                 | Methods (location definition; twelve single-site groups, parent and the excluded residual multiple-injury category in Additional file 1, Table S4; age-domain rules; CHARLS eligibility in Fig. 1).                                                                  |
| 5                             | Provide information about all included data sources and their main characteristics (reference, population represented, collection method, year, sex/age range, measurement method, sample size, as relevant). | Methods, GBD 2023 source and CHARLS cohort (GBD modelled estimates for 375 diseases/88 risks/204 countries; CHARLS multistage stratified cluster survey, four waves and measurement modules); GBD and CHARLS references [1,27] and [1]; Additional file 1, Table S4. |
| 6                             | Identify and describe any categories of input data that have potentially important biases.                                                                                                                    | Methods and Discussion (GBD modelled-not-counted values, cause/injury coding and ill-defined-code redistribution, successive GBD revisions; CHARLS self-reported recall; COVID-curtailed 2020 wave).                                                                 |
| 7                             | Describe and give sources for any other data inputs (not synthesised as part of the study).                                                                                                                   | Methods (GBD world standard population for age-standardisation); official Chinese population projections referenced only qualitatively in the Discussion; no external numeric values are pooled.                                                                     |

| Item                          | Recommendation (verbatim)                                                                                                                                                                  | Location in this manuscript                                                                                                                                                                                                                                                                                                                                                     |
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| 8                             | Provide all data inputs in an efficiently extractable format, with relevant metadata; for data that cannot be shared for ethical/legal reasons, provide the retaining institution/contact. | Declarations, Availability of data and materials (GBD freely downloadable per the Zenodo query manifest; CHARLS is registered-access public data with access route stated; aggregate derived tables and code on Zenodo<br><a href="https://doi.org/10.5281/zenodo.22700031">https://doi.org/10.5281/zenodo.22700031</a> ; individual-level CHARLS waves are not redistributed). |
| <b>Data analysis</b>          |                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                 |
| 9                             | Provide a conceptual overview of the data analysis method. A diagram may be helpful.                                                                                                       | Methods, Overall design and the two Statistical analysis subsections (analysis pipeline); Fig. 1 (cohort flow) and Fig. 10 (decomposition and qualitative cross-database design).                                                                                                                                                                                               |
| 10                            | Provide a detailed description of all steps of the analysis, including mathematical formulae (cleaning, pre-processing, adjustments/weighting, statistical/mathematical models).           | Methods, Statistical analysis: GBD (EAPC, joinpoint/BIC, additive Das-Gupta three-factor decomposition, ARIMA) and Statistical analysis: CHARLS (weighted logit-binomial GLM, cluster sandwich, splines); PAF fracture-pathway definition; full code on Zenodo.                                                                                                                 |
| 11                            | Describe how candidate models were evaluated and how the final model(s) were selected.                                                                                                     | Methods (ARIMA grid search p0-3/d0-1/q0-2 by AIC, neighbouring-order comparison; spline knot-placement check; joinpoint by BIC); Table 4; Additional file 1, Table S2A.                                                                                                                                                                                                         |
| 12                            | Provide results of an evaluation of model performance, if done, and of any relevant sensitivity analyses.                                                                                  | Results, Projection and Sensitivity analyses; Table 4 (Ljung-Box, 2014-2019 back-test MAPE $\approx 17\%$ ); Additional file 1, Tables S1-S2 (forced d=1, weights, IPW, extended and wave-specific checks).                                                                                                                                                                     |
| 13                            | Describe methods of calculating uncertainty; state which sources of uncertainty were and were not accounted for.                                                                           | Methods (GBD ensemble uncertainty is not a per-cell sampling interval, so none is attached; ARIMA 95% prediction intervals; CHARLS cluster-robust 95% CI; no cross-source uncertainty pooling).                                                                                                                                                                                 |
| 14                            | State how the analytical/statistical source code used to generate estimates can be accessed.                                                                                               | Declarations, Availability of data and materials; Zenodo<br><a href="https://doi.org/10.5281/zenodo.22700031">https://doi.org/10.5281/zenodo.22700031</a> (Python 3.12, statsmodels 0.15.0, pinned requirements, runnable scripts and aggregate tables).                                                                                                                        |
| <b>Results and discussion</b> |                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                 |
| 15                            | Provide published estimates in a file format from which data can be efficiently extracted.                                                                                                 | Tables 1-4 in the manuscript; all aggregate derived result tables provided as CSV in the Zenodo archive.                                                                                                                                                                                                                                                                        |
| 16                            | Report a quantitative measure of the uncertainty of the estimates.                                                                                                                         | Table 4 (2035 95% prediction intervals); EAPC 95% CI in Tables 1-3; CHARLS adjusted OR 95% CI in Tables 6-7.                                                                                                                                                                                                                                                                    |
| 17                            | Interpret results in light of existing evidence. If updating previous estimates, describe reasons for changes.                                                                             | Discussion, What drove the increase (reconciliation with Sui 2025 GBD 2021 and Huang 2025; note that the GBD 2023 hip series differs from earlier GBD releases, stated in Methods and limitations).                                                                                                                                                                             |

| Item | Recommendation (verbatim)                                                                                            | Location in this manuscript                                                                                                                                                                                                    |
|------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | Discuss limitations of the estimates, including modelling assumptions and data limitations affecting interpretation. | Discussion, limitations paragraph (modelled inputs and CRA assumptions, no provincial heterogeneity, univariate ARIMA without policy terms and wide intervals, count $\approx$ ASR $\times$ population identity not enforced). |