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Coverage-Aware Visualization of Global Trends in Selected Noncommunicable Disease Indicators Using WHO Open Data

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Abstract

Noncommunicable disease (NCD) indicators often appear as a global line, map, or dashboard tile. Such summaries can obscure coverage, dispersion, and unequal terminal years. We analysed frozen World Health Organization (WHO) Global Health Observatory OData snapshots for three age-standardized indicators: adult obesity, diabetes, and hypertension. The analysis used 12,636 retained entity-year records for both sexes and three views: regional entity-median trajectories, 2019 entity distributions, and matched-entity changes from 2000 to 2019. Obesity and diabetes each covered 199 WHO GHO country/area entities through 2021, whereas hypertension covered 194 through 2019; 2019 was therefore the shared calendar year. Across regions, median obesity estimates ranged from 2.8%–21.4% in 2000 and 8.5%–32.9% in 2021. Median diabetes estimates ranged from 5.8%–14.6% to 8.5%–21.2% over the same period. For matched entities, median changes from 2000 to 2019 were +7.03 percentage points for obesity, +3.28 for diabetes, and +0.35 for hypertension. Duplicate indicator–entity–year keys were tested before analysis; none were detected. The protocol makes the entity denominator, shared year, and pairing rule visible. Its results are descriptive summaries of published estimates with equal entity weight, not population-weighted global prevalence, causal effects, or clinical outcomes.

Keywords

WHO Global Health Observatory, noncommunicable diseases, prevalence trends, coverage-aware visualization, public health data analysis

1. Introduction

Noncommunicable diseases place a large and uneven burden on health systems, so comparable surveillance matters for public-health planning [1, 2]. Long-running pooled analyses have tracked international change in diabetes, blood pressure, and body-mass index [3–6]. That evidence is population-level and valuable, yet it cannot simply be carried over to a paper visualization built from a public indicator service. Such a visualization needs to show its included entities, aggregation rule, and the comparisons its data can support. The World Health Organization (WHO) Global Health Observatory (GHO) makes indicator records available through an OData interface with documented dimensions, filters, time queries, and WHO-region lookup [7–9]. Each record contains a geographic identifier, year, region, and numeric estimate. We used a response snapshot taken on 27 August 2026 because the live endpoint has no version identifier and can change. Indicator definitions,

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age eligibility, and update schedules mean that the records are not one uniform analytic cohort. Obesity and diabetes are available to 2021 for adults aged 18 years and older. Hypertension ends in 2019 and applies to adults aged 30–79 years. A latest-value display would combine different calendar periods and could obscure this age distinction.

Dashboards can make complex public-health information easier to reach, although reviews report considerable variation in design, data integration, and evaluation [10, 11]. NCD monitoring work likewise treats data availability and surveillance capacity as part of the evidence, rather than as background to the reported values [12, 13]. The design issue here is more specific: how can a static conference paper show temporal direction, cross-sectional heterogeneity, and comparable change without recasting entity medians as population-weighted global prevalence? The study concerns the presentation of published estimates; exposure, policy, and visualization effects are outside its scope. The analysis uses three coordinated views of WHO NCD trends: regional medians of available entity estimates, a common-year distribution retaining every entity point, and matched-entity absolute-change plots. It is an extraction-and-audit workflow, not a predictive model or usability study. Longitudinal trajectories are kept separate from cross-sectional comparisons whenever final years differ. Endpoint matching fixes the country/area entity composition, and the reported entity counts together with the common-entity sensitivity analysis show exactly what underlies each unweighted regional summary.

This paper contributes a reporting protocol rather than a prediction. Each indicator remains on its observed timeline instead of being forced to end in the same year. The indicators are compared in a shared calendar year, while the full entity distribution remains visible. Change is calculated only where the same entities are observed at both endpoints, and the common-entity sensitivity check makes the role of sample composition explicit. The result is a compact way to report heterogeneous public-health indicators without treating equal-entity summaries as population-weighted prevalence.

2. Related Work

Most global NCD trend estimates come from pooled measurements and burden-estimation programmes. Zhou et al. used 751 population-based studies to estimate worldwide diabetes trends [3]; their later hypertension analysis reported prevalence, treatment, and control across 1,201 studies [4]. The NCD Risk Factor Collaboration described body-mass-index trends in 200 countries, together with worldwide obesity and BMI-category patterns [5, 6]. Global Burden of Disease analyses consider disease burden and risk factors at a comparable geographic scale [1, 2]. Those studies provide relevant context, but the present analysis does not reproduce their models, denominators, or uncertainty procedures. It summarizes WHO country records instead, giving each entity equal weight. WHO-based monitoring is also analysed at national and regional scales. The National Noncommunicable Disease Monitoring Survey in India shows the value of structured risk-factor surveillance in a defined population [14]; a retrospective study in Samoa used repeated health-survey data to describe risk behaviours and protective factors [15]. Their questions and populations differ from this cross-country descriptive analysis. They also do not test aggregation across indicators with unequal age eligibility and terminal years. Visualization research adds a complementary concern. Public-health dashboard reviews show wide variation in data sources, interaction, and intended users [10]. Work on visualization and decision-making cautions that value rests on the task and evidence, not on graphics alone [11]. Accordingly, this paper does not claim that its views improve decisions. It specifies a paper-oriented protocol in which visible constraints make descriptive inferences auditable.

3. Data and Methods

3.1 Data Source and Eligibility

We analysed three WHO GHO OData responses frozen at 01:54 UTC on 27 August 2026 [7]. Because the endpoint has no version identifier, the snapshot date identifies the data used in this analysis. A record was eligible when it referred to a WHO COUNTRY geographic entity, both sexes, a listed WHO region, a numeric estimate, and a year from 2000 onward. We use “entity” because the 199 retained WHO GHO COUNTRY identifiers include country/area geographic entities. All values are age-standardized WHO estimates, although obesity and diabetes apply to adults aged 18 years and older and hypertension to adults aged 30–79 years. The

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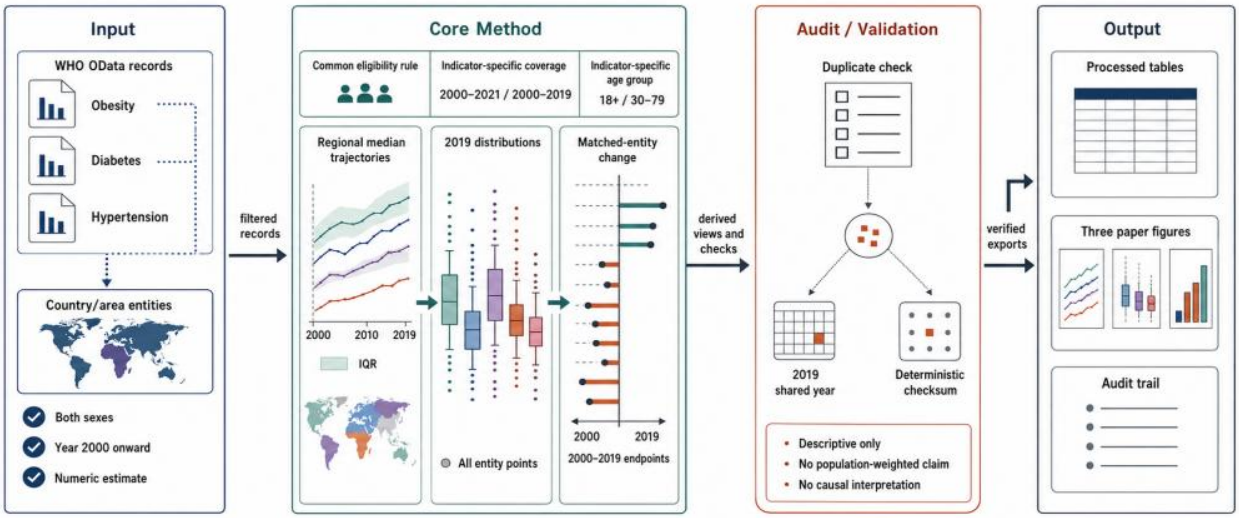
analysis retained 4,378 obesity observations from 199 entities for 2000–2021, 4,378 diabetes observations from 199 entities for 2000–2021, and 3,880 hypertension observations from 194 entities for 2000–2019. No population denominators were applied. The resulting aggregates therefore describe distributions of available entity estimates, not prevalence among people in a regional or global population. Table 1 records the public WHO indicator codes and definitions, age groups, coverage years, retained record totals, and entity denominators used in the analysis.

Table 1: Data definition and retained coverage. All values are WHO age-standardized percentage estimates from the frozen OData responses, filtered to both sexes and WHO GHO COUNTRY geographic entities

WHO code	Indicator definition	Age group	Years	Records	Entities
NCD_BMI_30A	Obesity, BMI ≥ 30 kg/m^2	18+	2000–2021	4,378	199
NCD_DIABETES_PREVALENCE_AGESTD	Diabetes prevalence	18+	2000–2021	4,378	199
NCD_HYP_PREVALENCE_A	Hypertension prevalence	30–79	2000–2019	3,880	194

Figure 1 summarizes the protocol. The first stage filters the three OData extracts through a common eligibility rule. The second stage preserves indicator-specific coverage and age-group labels. The final stage creates three complementary views and validation checks. This descriptive workflow is neither a trained model nor an account of disease mechanisms.

Figure 1: Three views for coverage-aware analysis. Numeric observations for both sexes in WHO GHO country/area entities are retained, then displayed as regional entity-median trajectories, a 2019 distribution with indicator-specific entity sets, and matched-entity change from 2000 to 2019. Coverage checks accompany the views; the figure does not imply population-weighted or causal inference



3.2 Three-view Descriptive Protocol

For indicator j, entity i, WHO region r, and year t, let x_{irjt} be the published numeric estimate; r denotes the six WHO regions. The trajectory view uses the median M_{rjt}=median$_i$(x_{irjt}) for available entities in each region. The accompanying interquartile range (IQR) describes the middle half of entity estimates. Regional medians were chosen instead of means because a small number of high or low country/area estimates can pull an arithmetic average, particularly where regions have unequal numbers of available entities. The IQR makes the spread around each median visible, whereas the raw entity points in the distribution panel retain the observations behind the summary. These complementary displays limit the influence of extremes without concealing heterogeneity or turning an equal-entity statistic into a regional-population estimate. We use 2019 for the cross-indicator display because it is the last year shared by all three series. In each WHO region, the distribution panel places individual entity points alongside a boxplot. The 2019 data contain 199 obesity, 199 diabetes, and 194 hypertension entities, or 592 indicator–entity records. No combined prevalence estimate is created. For the sensitivity check, all series are restricted to the 194 country/area entities represented throughout, leaving 582 records. The change panel includes only entities observed in both 2000 and 2019 and

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calculates $\Delta_{irj}=x_{irj,2019}-x_{irj,2000}$ in percentage points. Matching the endpoints fixes entity identity, so Δ_{irj} is a difference between published entity estimates, not an incidence measure or causal effect.

3.3 Audit and Sensitivity Checks

We ran the coverage, regional-summary, and sensitivity checks against the frozen JSON responses. First, we examined the indicator–entity–year keys; none was duplicated. We then verified common-year availability and the stated paired-entity interpretation. These checks support the integrity of the descriptive workflow only. They do not assess model performance, population-weighted burden, or causal effects.

4. Results and Visualization Analysis

4.1 Coverage and Audit Results

Eligibility filtering yielded 12,636 entity-year records. Every retained value was numeric, and each indicator–entity–year key was unique. In the shared 2019 display, the indicator-specific sets comprised 199 obesity, 199 diabetes, and 194 hypertension entities, or 592 indicator–entity records. The strict three-indicator intersection contained 194 entities and 582 records. Table 2 gives the largest regional-median shift after that restriction. These summaries are unweighted at the entity level and are not population estimates or causal comparisons. Table 2 summarizes the common-entity sensitivity analysis. Restricting obesity and diabetes to the 194-entity intersection changes their Western Pacific regional medians by 4.30 and 1.31 percentage points, respectively. The largest shift therefore occurred where the entity-set restriction had the most visible effect on a regional summary. This result isolates coverage sensitivity within a design that otherwise retains each indicator's available entity set. It shows why entity denominators are part of the interpretation of a regional median, rather than a reporting detail that can be omitted.

Table 2: Common-entity sensitivity check. For each indicator, the reported difference is the largest absolute change in a 2019 WHO-region median after its entity set is restricted to the 194 entities shared across all three series

Indicator	Full entities	Common entities	Largest difference (pp)	Region
Obesity	199	194	4.30	Western Pacific
Diabetes	199	194	1.31	Western Pacific
Hypertension	194	194	0.00	All regions

4.2 Regional Trajectories

Figure 2 presents entity-median trajectories and IQR bands for all six WHO regions. Regional median obesity estimates ranged from 2.8% to 21.4% in 2000 and from 8.5% to 32.9% in 2021. The entity median in Africa rose from 4.2% to 11.2%, while the Western Pacific median rose from 19.5% to 32.9%. The corresponding diabetes ranges were 5.8%–14.6% and 8.5%–21.2%; the Eastern Mediterranean increased from 14.6% to 21.2% and Africa from 6.9% to 10.6%. Hypertension had a narrower change over its available series, with regional medians ranging from 31.0% to 41.0% in 2000 and 34.7% to 40.9% in 2019. The panels make the differing age labels and final years visible, which is essential when readers compare their trajectories.

4.3 Common-year Heterogeneity and Matched-entity Change

Figure 3 uses the shared calendar year to show the distribution behind each regional median. It retains all available entities for each indicator in 2019, rather than restricting the points to the 194-entity intersection. The raw points show dispersion within regions and prevent a central line from standing alone. In 2019, the largest regional median for obesity was 31.38% in the Western Pacific, whereas the South-East Asia median was 7.79%. For diabetes, the Eastern Mediterranean median was 21.09% and the Europe median was 8.04%. Entity counts range from 10 in South-East Asia to 52 in Europe for diabetes and obesity, while hypertension has 10 to 51 entities by region. Readers can therefore relate unweighted entity summaries to coverage rather than interpreting them as population burdens or causal contrasts.

Figure 4 restricts the change analysis to entities observed at both endpoints. The median 2000–2019 change was +7.03 percentage points for obesity (IQR 4.63–10.85; n=199), +3.28 for diabetes (IQR 1.32–5.26; n=199), and +0.35 for hypertension (IQR −2.00 to 3.27; n=194). The scatterplots retain the baseline estimate for each

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entity and make visible that the three indicators have different distributions of change. Their role is descriptive: potential explanations require data and designs that are outside the present protocol.

Figure 2: Main result: regional trajectories of entity-level WHO estimates. Lines are medians of available country/area entity estimates in each WHO region; shaded bands are IQRs. Obesity and diabetes extend to 2021, whereas hypertension ends in 2019

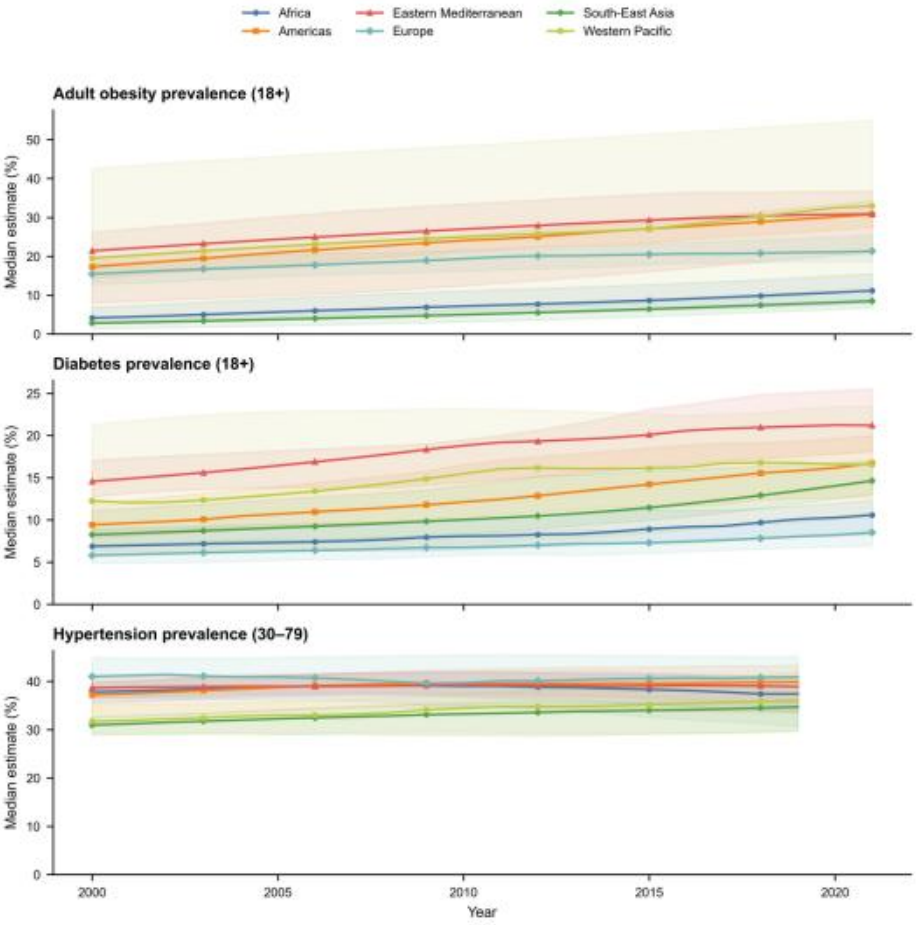

Figure 3: Entity distributions in the shared 2019 calendar year. Boxes show the distribution of WHO GHO country/area entity estimates within each WHO region, and coloured points show individual entities. The panels retain 199 obesity, 199 diabetes, and 194 hypertension observations (592 records), rather than only the 194-entity intersection

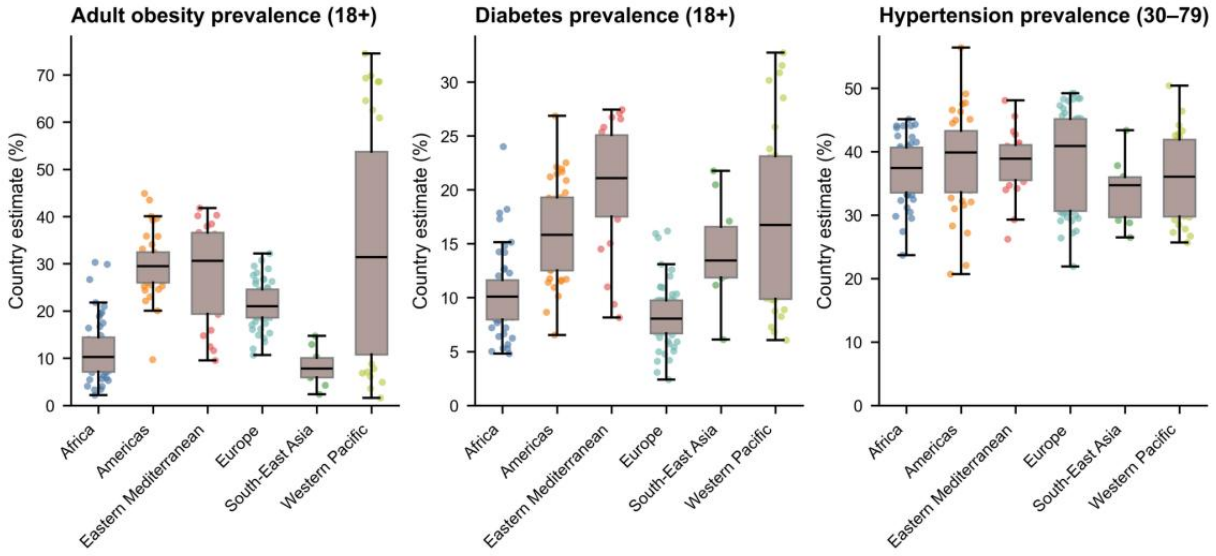

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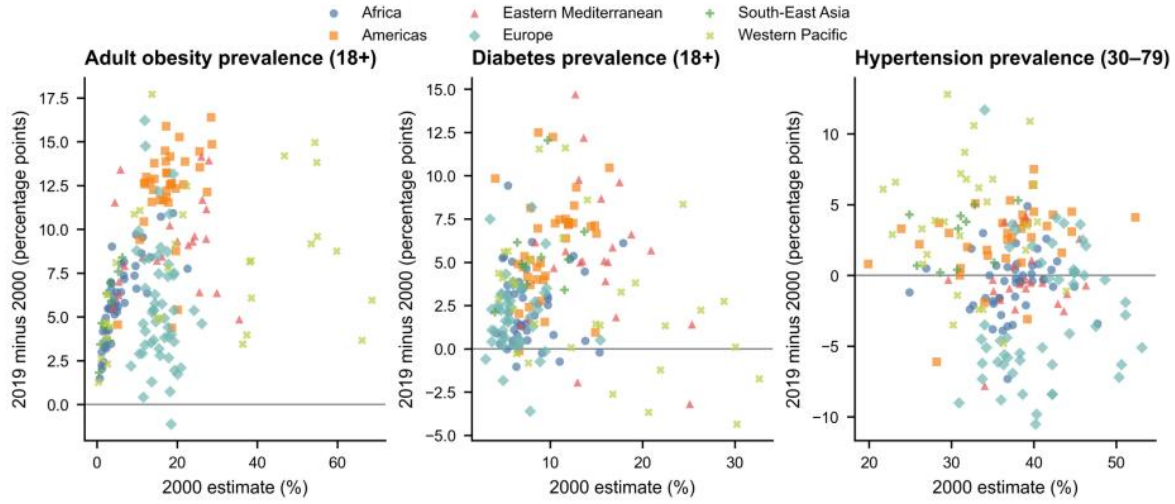
Figure 4: Matched-entity change from 2000 to 2019. Each point is a WHO GHO country/area entity observed at both dates; the horizontal line marks zero absolute change



5. Discussion

The directions in the three series are consistent with published accounts of change in diabetes, blood pressure, and obesity across settings [3–6]. They should not be read as the population-weighted estimates produced in pooled studies. Here, we compare direction, regional ordering, and entity-level dispersion. The trajectory panels show movement over time; shared-year distributions reveal the spread behind regional medians; and paired plots are limited to entities whose identity is fixed. One aggregate line would hide that dispersion, while a map alone would say less about temporal direction. The three views also prevent different data structures from being treated as the same comparison. A trajectory can show temporal direction but not the entity-level spread in a given year. A shared-year distribution can show that spread but cannot establish whether an entity changed over time. The paired change view fixes entity identity across endpoints, yet still requires the baseline estimate to interpret the magnitude and pattern of change. Used together, the panels link trend, heterogeneity, and matched change without collapsing them into a single summary statistic. The layout separates comparisons that can otherwise appear equivalent. Choosing 2019 as the shared display year prevents 2021 obesity or diabetes values from being read as contemporaneous with hypertension ending in 2019. The common-entity sensitivity analysis shows that the five entities absent from the hypertension series can materially shift the Western Pacific median for obesity and diabetes. The reported denominators, raw points, and intersection result make that restriction directly visible. The sensitivity result also gives the coverage rule a substantive role in interpretation. The 4.30 percentage-point obesity shift in the Western Pacific shows that a small difference in the available entity set can alter a regional median even when the indicator definition is unchanged. The smaller diabetes shift and the zero hypertension shift show that this effect is not uniform across indicators. Accordingly, the common-entity analysis is not a substitute for the indicator-specific display; it identifies where an equal-entity regional comparison is sensitive to the coverage restriction. The limitations are consequential. WHO estimates differ in definitions, uncertainty, and update practice, and the age ranges are not harmonized. Equal-entity medians need documented denominators and a prespecified aggregation rule before population weighting can be considered. The static figures were not tested in a user study. Future work could apply a stated population-weighted protocol and ask whether the three views improve interpretation for intended public-health users.

6. Conclusion

Using three WHO NCD indicator series, we applied a descriptive workflow designed to keep coverage visible. It draws on 12,636 entity-year records and reports the entity denominators, a shared 2019 display, a 194-entity sensitivity analysis, and matched-entity changes. This keeps time coverage, age boundaries, and equal-entity aggregation explicit. Obesity and diabetes show broadly upward regional entity-median

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trajectories, whereas hypertension has a smaller median matched-entity change. These are non-population-weighted descriptive findings, not estimates of population prevalence, causal effects, or clinical outcomes.

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Conflicts of Interest

The authors declare no conflict of interest.

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