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Zero-dose vaccination in West and Central Africa after the COVID-19 disruption: trends, subregional inequalities and recovery, 2019-2024

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Abstract

Background

Immunization Agenda 2030 (IA2030) aims to halve the number of zero-dose children from the 2019 baseline, but progress across West and Central Africa is uneven. We compared post-pandemic trajectories, recovery to pre-COVID-19 levels and between-country inequality in initial access to routine immunization across the two subregions.

Methods

We conducted a secondary ecological analysis of the WHO/UNICEF Estimates of National Immunization Coverage (WUENIC), using the 2025 revision for 25 countries in geographic Western Africa (n = 16) and Middle Africa/Central Africa (n = 9). Zero-dose prevalence was defined as 100 minus DTP1 coverage. We summarized annual distributions from 2019 to 2024 using medians, interquartile ranges, means, coefficients of variation and unweighted Gini coefficients. Recovery, country-rank persistence and subregional differences were also examined.

Results

Across all 25 countries, median zero-dose prevalence increased from 14.0% in 2019 to 19.0% in 2021 and declined to 13.0% in 2024. The 2024 median remained substantially higher in Central Africa than in West Africa (18.0% vs 8.5%; Mann–Whitney U = 26, p = 0.010). Six countries had zero-dose prevalence ≥ 20% in 2024—four in Central Africa and two in West Africa—whereas all six countries at ≤ 5% were in West Africa. The pooled Gini coefficient was 0.394 in 2019, peaked at 0.411 in 2022 and was 0.386 in 2024. From 2019 to 2024, 12 countries improved, three were unchanged and 10 worsened; 15 of 25 had returned to or exceeded their 2019 DTP1 level. Country rankings remained strongly persistent (Spearman rho = 0.711; p < 0.001), while the paired 2019–2024 distribution showed no uniform shift (Wilcoxon p = 0.625).

Conclusions

Regional recovery masks a durable subregional divide. West Africa experienced a pandemic-era setback followed by partial recovery, whereas Central Africa entered the period with much larger access gaps and still had more than twice the median zero-dose prevalence of West Africa in 2024. IA2030 acceleration should combine protection of gains in higher-performing programmes with concentrated, subnationally targeted primary-health-care and immunization investments in persistent high-burden settings.

Background

Immunization is one of the most effective public-health interventions, but its benefits depend on whether routine services reach children early and equitably. The Immunization Agenda 2030 (IA2030) places this equity challenge at the centre of global vaccination policy and includes an impact goal to reduce the number of zero-dose children by 50% from the 2019 baseline by 2030 [1, 2]. In routine global monitoring, a child who has not received the first dose of a diphtheria-tetanus-pertussis-containing vaccine (DTP1) is used as an operational proxy for a zero-dose child, making DTP1 a practical tracer of initial contact with routine immunization services [2].

The WHO/UNICEF Estimates of National Immunization Coverage (WUENIC) provide the most widely used standardized national coverage time series. Each annual revision combines country-reported administrative and official coverage, eligible household surveys and contextual information, with a country-by-country technical review by WHO and UNICEF [3, 4]. Historical values can therefore change between revisions when new survey or programme evidence becomes available. For the present study, we used the 2025 WUENIC revision, completed in July 2026, to obtain a consistent historical series through 2024 [3, 4].

West and Central Africa are often discussed together in immunization policy, yet the two subregions start from very different baselines. West Africa includes several countries with sustained high DTP1 coverage alongside a smaller group with persistent access gaps, and recent programme reviews have highlighted stagnation, financing constraints, data-quality problems and uneven recovery after COVID-19 [5]. Central Africa contains a larger concentration of fragile and conflict-affected settings, and survey evidence from the Democratic Republic of the Congo (DRC) illustrates how national averages can conceal very large provincial differences in zero-dose prevalence [11–13].

The COVID-19 pandemic intensified pre-existing service disruptions and was followed by the global Big Catch-Up and other recovery efforts [6]. Global analyses showed that between-country inequalities in routine childhood vaccination widened during the early pandemic years [14]. WHO global reporting for 2024 likewise showed that DTP1 coverage remained below pre-pandemic levels and that the estimated number of zero-dose children was still above the 2019 baseline [17]. However, an apparent regional recovery can still conceal a persistent subregional divide or highly divergent country trajectories. A pooled analysis of West and Central Africa is therefore most informative when it explicitly compares the two subregions rather than relying on a single regional mean.

We assessed country-level trends in zero-dose prevalence across 25 West and Central African countries from 2019 to 2024. Our objectives were to describe post-pandemic recovery, compare West and Central Africa, quantify between-country dispersion, identify countries that had or had not returned to their 2019 DTP1 level, and determine whether relative country rankings remained persistent over time.

Methods

Study design and geographic scope

We conducted a secondary ecological study using annual national immunization coverage estimates. The unit of analysis was the country-year. The study included 25 countries using United Nations geographic groupings: 16 in Western Africa (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo) and nine in Middle Africa, referred to here as Central Africa for readability (Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon and Sao Tome and Principe).

Data source

Country-level DTP1 coverage for 2019–2024 was extracted from the WHO/UNICEF WUENIC 2025 revision, released on 15 July 2026. The WUENIC series represents WHO/UNICEF estimates, not unadjusted administrative coverage, and is produced through a standardized review process that triangulates official country reports, administrative data, eligible survey estimates and relevant contextual information [3, 4]. Using the most recent revision ensures that all study years are analysed within one internally consistent release. This also means that some historical values differ from earlier WUENIC revisions used in previous drafts.

Outcome and operational definitions

The primary outcome was annual zero-dose prevalence, calculated as 100 minus WUENIC DTP1 coverage. DTP1 coverage was interpreted as the proportion of surviving infants who received at least one DTP-containing vaccine dose. The indicator therefore captures failure to enter the routine immunization pathway and should not be interpreted as proof that a child received no vaccine antigen of any kind [2, 7].

Statistical analysis

For each year and geography (Western Africa, Central Africa and the pooled 25-country set), we calculated the unweighted median, interquartile range (IQR), mean, standard deviation (SD), coefficient of variation (CV), minimum, maximum and IQR width of country-level zero-dose prevalence. Between-country dispersion was summarized with an unweighted Gini coefficient. A value of zero indicates equality across countries, while higher values indicate greater dispersion. Because countries were given equal weight, the Gini coefficient was interpreted as heterogeneity between national programmes rather than as a population-weighted measure of individual inequality [14].

Recovery was assessed by comparing each country's DTP1 coverage in 2024 with its 2019 value. Change in zero-dose prevalence was expressed in percentage points; negative values denote improvement. To describe the two tails of the distribution, we counted countries with zero-dose prevalence ≤ 5% and ≥ 20%. Spearman's rank correlation assessed persistence in country ranking

between 2019 and 2024. The Wilcoxon signed-rank test compared paired 2019 and 2024 values, while the Friedman test explored differences across all six annual observations. The Mann–Whitney U test compared the two subregions descriptively in selected years. Because the analysis covered the full set of countries in the defined geography rather than a probability sample, p-values were treated as descriptive indicators of pattern consistency and not as inference to a broader super-population of countries. A two-sided $p < 0.05$ was used as a conventional reference threshold. Analyses were performed in Python 3.11 using NumPy and SciPy.

Ethical considerations

The study used publicly available, aggregated national estimates and did not involve individual-level records, identifiable personal information, participant contact or biological specimens. Ethics committee review and informed consent were therefore not required.

Results

Overall trajectory across 25 countries

Across the 25 countries, median zero-dose prevalence was 14.0% (IQR 7.0–23.0) in 2019. It increased to 17.0% in 2020 and peaked at 19.0% in 2021. The median then declined to 16.0% in 2022, 16.0% in 2023 and 13.0% (IQR 7.0–19.0) in 2024. The pooled mean changed little between 2019 and 2024 (16.3% vs 15.8%), but this apparent stability concealed sharply different subregional trajectories.

West–Central subregional divide

West Africa started from a substantially better position. Its median zero-dose prevalence rose from 7.5% in 2019 to 11.0% in 2021, then fell to 8.5% in 2024. Central Africa started much higher, at a median of 23.0% in 2019; it remained at 24.0% in 2021 and declined to 18.0% in 2024. The median gap between the subregions narrowed from 15.5 percentage points in 2019 to 9.5 points in 2024, but remained large. In 2024 the country distributions still differed markedly (Mann–Whitney $U = 26$, $p = 0.010$). The contrasting subregional trajectories are shown in Fig. 1.

Between-country dispersion and polarization

The pooled Gini coefficient was 0.394 in 2019, decreased during the first pandemic year, rose to a six-year high of 0.411 in 2022 and returned to 0.386 in 2024. Within-subregion Gini values changed little between 2019 and 2024: 0.379 to 0.380 in West Africa and 0.262 to 0.266 in Central Africa. The more important inequality signal was therefore the persistent level difference between the two subregions rather than a major rise in within-subregion dispersion.

In 2024, six countries had zero-dose prevalence of at least 20%: Central African Republic (48%), Gabon (38%), Angola (30%), Nigeria (29%), Equatorial Guinea (25%) and Guinea (23%). Four of these six were in Central Africa. At the opposite end, six countries were at or below 5%—Burkina Faso, Mauritania, Niger,

Togo, Senegal and Ghana—and all were in West Africa. No Central African country was at or below 5% in 2024. The 2024 country ranking and the 5% and 20% reference thresholds are shown in Fig. 2.

Country recovery and persistent ranking

From 2019 to 2024, 12 of 25 countries reduced zero-dose prevalence, three were unchanged and 10 worsened. Fifteen countries (60%) had DTP1 coverage in 2024 that was equal to or higher than their 2019 level. The median country-level change was 0.0 percentage points (IQR − 5.0 to 2.0), with changes ranging from − 14 to + 15 points. The largest improvements were in Chad (− 14 points), Cameroon (− 10), Guinea (− 10), Mali (− 9), Congo (− 8) and Mauritania (− 7). The largest deteriorations were in Gabon (+ 15), Côte d'Ivoire (+ 13), The Gambia (+ 11) and Sao Tome and Principe (+ 10).

Recovery was heterogeneous in both subregions. In West Africa, eight countries improved, two were unchanged and six worsened; 10 of 16 had returned to or exceeded their 2019 DTP1 level. In Central Africa, four improved, one was unchanged and four worsened; five of nine had recovered to baseline. The paired 2019–2024 comparison showed no uniform shift across the pooled 25-country distribution (Wilcoxon $W = 111.5$, $p = 0.625$), and the Friedman test across 2019–2024 was borderline but not conventionally significant ($\chi^2(5) = 10.62$, $p = 0.059$). In contrast, country rankings were strongly persistent (Spearman $rho = 0.711$, $p < 0.001$), indicating that countries starting with relatively high zero-dose prevalence often remained among the higher-burden settings in 2024.

Discussion

Principal findings

This comparative analysis changes the interpretation that emerges from looking at West Africa alone. Across the 25 countries, the typical country showed a pandemic-era deterioration followed by recovery, but the dominant feature in 2024 was a persistent West–Central divide. The median zero-dose prevalence in Central Africa remained more than twice that of West Africa, and four of the six countries above the 20% threshold were in Central Africa. At the same time, country trajectories were not uniformly negative: Chad, Cameroon and Congo recorded substantial gains, showing that poor baseline performance did not make improvement impossible.

The pooled Gini coefficient did not rise materially between 2019 and 2024, and within-subregion Gini values were also broadly stable. This matters because a single inequality statistic can obscure the structure of the problem. Here, the main equity concern was not simply widening dispersion within West or Central Africa; it was the coexistence of two markedly different subregional distributions, combined with a persistent set of high-burden countries. The strong rank correlation between 2019 and 2024 is consistent with path dependence in national programme performance and complements global evidence that cross-country inequalities in routine vaccination intensified during the early COVID-19 period [14].

Central Africa requires differentiated acceleration

Central Africa entered the study period with a median zero-dose prevalence of 23% and still stood at 18% in 2024. The improvement is meaningful, but the residual burden remains substantial. The Central African Republic and Gabon illustrate different but equally concerning trajectories: the former improved slightly yet remained at an estimated 48% zero-dose prevalence in 2024, whereas Gabon deteriorated by 15 percentage points from its 2019 level. Angola showed no net change, while Equatorial Guinea and the DRC were slightly worse than baseline. These patterns argue against treating Central Africa as a single homogeneous programme environment.

The DRC provides an important example of why national averages should be interpreted cautiously. A large provincial survey found an overall zero-dose prevalence of about one in five children aged 12–23 months, but provincial estimates ranged from 2.4% to 62.4% [11]. Associated factors included maternal education, young maternal age, household assets, knowledge, charges related to vaccination services and lack of civil registration [11]. A companion analysis distinguished motivational barriers among zero-dose children from more practical programme barriers among under-vaccinated children [12], while a later rural analysis suggested that caregiver attitudes could be more strongly associated with zero-dose status than travel time to the nearest facility [13]. These findings support subnational diagnosis rather than uniform national solutions.

West Africa: recovery with a persistent high-burden tail

West Africa had a lower baseline burden and a clearer pandemic-era spike, with the median increasing from 7.5% in 2019 to 11.0% in 2021 before falling to 8.5% in 2024. However, the subregion did not simply return to its pre-pandemic distribution. Nigeria remained near 30%, Guinea remained above 20%, and large deteriorations in Côte d’Ivoire and The Gambia offset gains elsewhere. Recent regional programme analysis has similarly emphasized that routine immunization performance in West Africa is shaped by system capacity, financing, service continuity and data use rather than by a single common bottleneck [5].

Nigeria remains especially important because its population size converts high zero-dose prevalence into a very large absolute number of missed children. A comprehensive review of zero- and missed-dose children in Nigeria identified maternal education, access to vaccination, facility proximity, community heterogeneity, awareness and service availability as recurrent determinants, while noting that intervention evidence was still heavily concentrated on campaigns rather than sustainable routine delivery [10]. This reinforces the need to link zero-dose strategies to primary health care, not only to periodic catch-up activities.

Programmatic implications for IA2030

The findings support a differentiated three-part response. First, countries already at or below 5% zero-dose prevalence should protect service reliability and use fine-grained microplanning to identify residual

pockets before they widen. Second, countries in the 10–20% range need stronger second-order improvements in outreach, defaulter tracing, local data use and community engagement. Third, countries at or above 20% require intensive, geographically targeted strategies that combine immunization with broader primary-health-care access, especially in fragile, mobile, conflict-affected and peri-urban populations. The Big Catch-Up remains important, but durable IA2030 progress will depend on whether catch-up efforts translate into stronger routine platforms [6].

Zero-dose status is also a marker of exclusion from other services. Multi-country evidence shows that children at greatest risk of non-vaccination are often also missed by antenatal, delivery and other primary-care contacts [7–9]. Integrating immunization with maternal and child health contacts, community platforms and civil registration systems may therefore generate benefits that extend beyond vaccination. This is particularly relevant in settings where household disadvantage, weak service trust and access barriers interact.

Data and measurement considerations

WUENIC is the most appropriate source for cross-country comparison because it applies a standardized annual review, but it remains dependent on the quality and availability of administrative data, surveys and national denominators [3, 4, 15]. The present results also demonstrate why authors should specify the WUENIC revision used. Historical values can be revised substantially when new evidence is incorporated; accordingly, the West Africa estimates in this manuscript differ in several countries from earlier drafts based on the 2024 revision. For transparent reproducibility, the study period and the WUENIC release should always be reported together.

Strengths and limitations

This study has several strengths. It uses one internally consistent WUENIC revision for all study years, expands the analysis to both West and Central Africa, separates pooled from subregional trends, and combines central tendency, dispersion, polarization, recovery and rank persistence. The comparative design shows patterns that are not visible in a West-Africa-only analysis, particularly the persistent excess burden in Central Africa.

Several limitations should also be recognized. The analysis is ecological and national-level; it cannot identify subnational clusters of zero-dose children or establish causal relationships between health-system factors and coverage. DTP1 is an operational proxy for zero-dose status and is not equivalent to having received no antigen of any kind. Country-level summaries and Gini coefficients are unweighted, so they describe heterogeneity between national programmes rather than the population-weighted burden among children. The same weight is given to Nigeria and Sao Tome and Principe despite their very different birth cohorts. The p-values are descriptive because the analysis covers the full defined geography rather than a sample of countries. Finally, WUENIC is revised annually, and future releases may update historical estimates.

Conclusions

West and Central Africa did not experience one common recovery pathway after the COVID-19 disruption. Across 25 countries, the pooled median zero-dose prevalence was slightly lower in 2024 than in 2019, but that summary masks a persistent subregional divide: Central Africa still had more than twice the median zero-dose prevalence of West Africa. Strong persistence in country rankings and the concentration of very high prevalence in a small group of countries indicate that structural access gaps remain entrenched. Accelerating IA2030 will require country- and subnationally specific strategies that protect gains where access is strong while concentrating immunization, primary-health-care, data and community investments in persistent high-burden settings.

Table 1
Country-level DTP1 coverage, derived zero-dose prevalence and change from 2019 to 2024 in West and Central Africa.

Country	Subregion	DTP1 2019 (%)	DTP1 2024 (%)	Zero-dose 2019 (%)	Zero-dose 2024 (%)	Change (pp)	Recovered
Nigeria	West	72	71	28	29	+ 1	No
Guinea	West	67	77	33	23	-10	Yes
Benin	West	81	81	19	19	+ 0	Yes
Côte d'Ivoire	West	94	81	6	19	+ 13	No
Gambia	West	93	82	7	18	+ 11	No
Guinea-Bissau	West	91	89	9	11	+ 2	No
Liberia	West	86	91	14	9	-5	Yes
Mali	West	82	91	18	9	-9	Yes
Sierra Leone	West	95	92	5	8	+ 3	No
Cabo Verde	West	96	93	4	7	+ 3	No
Burkina Faso	West	95	95	5	5	+ 0	Yes
Mauritania	West	88	95	12	5	-7	Yes
Niger	West	92	95	8	5	-3	Yes
Togo	West	93	95	7	5	-2	Yes
Senegal	West	93	96	7	4	-3	Yes
Ghana	West	97	99	3	1	-2	Yes
Central African Republic	Central	50	52	50	48	-2	Yes
Gabon	Central	77	62	23	38	+ 15	No
Angola	Central	70	70	30	30	+ 0	Yes
Equatorial Guinea	Central	77	75	23	25	+ 2	No
Cameroon	Central	72	82	28	18	-10	Yes
Democratic Republic of the	Central	84	82	16	18	+ 2	No

DTP1, first dose of diphtheria-tetanus-pertussis-containing vaccine; pp, percentage points. Zero-dose prevalence = 100 − WUENIC DTP1. Negative change indicates improvement. "Recovered" means 2024 DTP1 coverage was equal to or higher than the 2019 value.

Country	Subregion	DTP1 2019 (%)	DTP1 2024 (%)	Zero-dose 2019 (%)	Zero-dose 2024 (%)	Change (pp)	Recovered
Congo							
Chad	Central	69	83	31	17	-14	Yes
Sao Tome and Principe	Central	97	87	3	13	+ 10	No
Congo	Central	82	90	18	10	-8	Yes

DTP1, first dose of diphtheria-tetanus-pertussis-containing vaccine; pp, percentage points. Zero-dose prevalence = 100 − WUENIC DTP1. Negative change indicates improvement. "Recovered" means 2024 DTP1 coverage was equal to or higher than the 2019 value.

Table 2
Annual distribution and inequality of zero-dose prevalence by geography, 2019–2024.

Year	Geography	Median (IQR), %	Mean (SD), %	CV	Gini	≤ 5% / ≥20%, n
2019	Combined	14.0 (7.0–23.0)	16.3 (12.0)	0.738	0.394	5 / 8
2019	West Africa	7.5 (5.8–15.0)	11.6 (8.8)	0.761	0.379	4 / 2
2019	Central Africa	23.0 (18.0–30.0)	24.7 (12.8)	0.520	0.262	1 / 6
2020	Combined	17.0 (7.0–26.0)	18.0 (12.1)	0.670	0.359	2 / 11
2020	West Africa	9.5 (7.0–18.5)	13.4 (8.9)	0.663	0.339	1 / 4
2020	Central Africa	26.0 (23.0–31.0)	26.1 (13.1)	0.502	0.248	1 / 7
2021	Combined	19.0 (7.0–24.0)	18.0 (12.8)	0.711	0.373	3 / 9
2021	West Africa	11.0 (6.0–19.0)	14.1 (10.8)	0.763	0.386	2 / 3
2021	Central Africa	24.0 (19.0–24.0)	24.8 (13.8)	0.555	0.264	1 / 6
2022	Combined	16.0 (7.0–24.0)	17.2 (13.5)	0.785	0.411	5 / 8
2022	West Africa	7.0 (5.0–16.2)	11.9 (10.0)	0.844	0.421	5 / 3
2022	Central Africa	24.0 (18.0–35.0)	26.6 (14.2)	0.534	0.268	0 / 5
2023	Combined	16.0 (7.0–20.0)	15.6 (10.9)	0.698	0.359	5 / 8
2023	West Africa	8.0 (5.0–16.5)	11.5 (8.5)	0.740	0.387	5 / 3
2023	Central Africa	20.0 (18.0–21.0)	22.8 (11.2)	0.494	0.208	0 / 5
2024	Combined	13.0 (7.0–19.0)	15.8 (11.5)	0.733	0.386	6 / 6
2024	West Africa	8.5 (5.0–18.2)	11.1 (8.0)	0.727	0.380	6 / 2
2024	Central Africa	18.0 (17.0–30.0)	24.1 (12.5)	0.518	0.266	0 / 4

IQR, interquartile range; SD, standard deviation; CV, coefficient of variation. Gini coefficients are unweighted and describe between-country dispersion. The last column reports the number of countries at ≤ 5% and ≥ 20% zero-dose prevalence.

Declarations

Ethics approval and consent to participate

Not applicable. This study used publicly available, aggregated national data and did not involve human participants, identifiable personal data or biological specimens.

Consent for publication

Not applicable.

Availability of data and materials

The analysis is based on the publicly available WHO/UNICEF Estimates of National Immunization Coverage (WUENIC), 2025 revision. The derived 2019 and 2024 country-level values used in the main comparison are reproduced in Table 1. The analytical dataset can be reconstructed from the cited WUENIC source.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Wankpaouyare Gmakouba conceived the study, curated the data, designed and performed the secondary analyses, interpreted the findings and drafted the manuscript. All co-authors reviewed and approved the final manuscript and confirm their individual contributions before submission.

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Figures

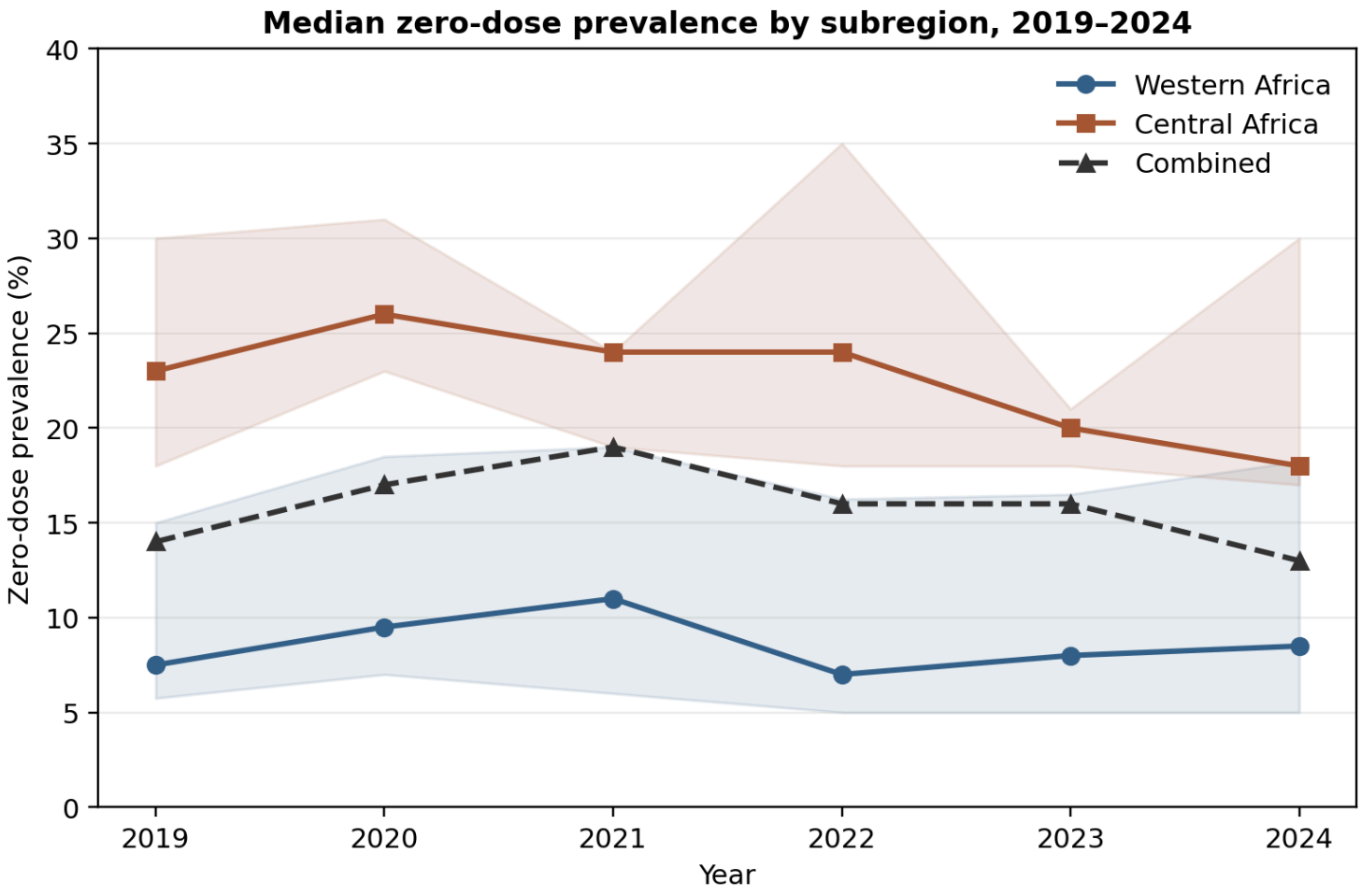


Figure 1

Median zero-dose prevalence by subregion, 2019–2024. Lines show annual medians; shaded bands show the interquartile range for Western and Central Africa. Zero-dose prevalence = 100 − WUENIC DTP1.

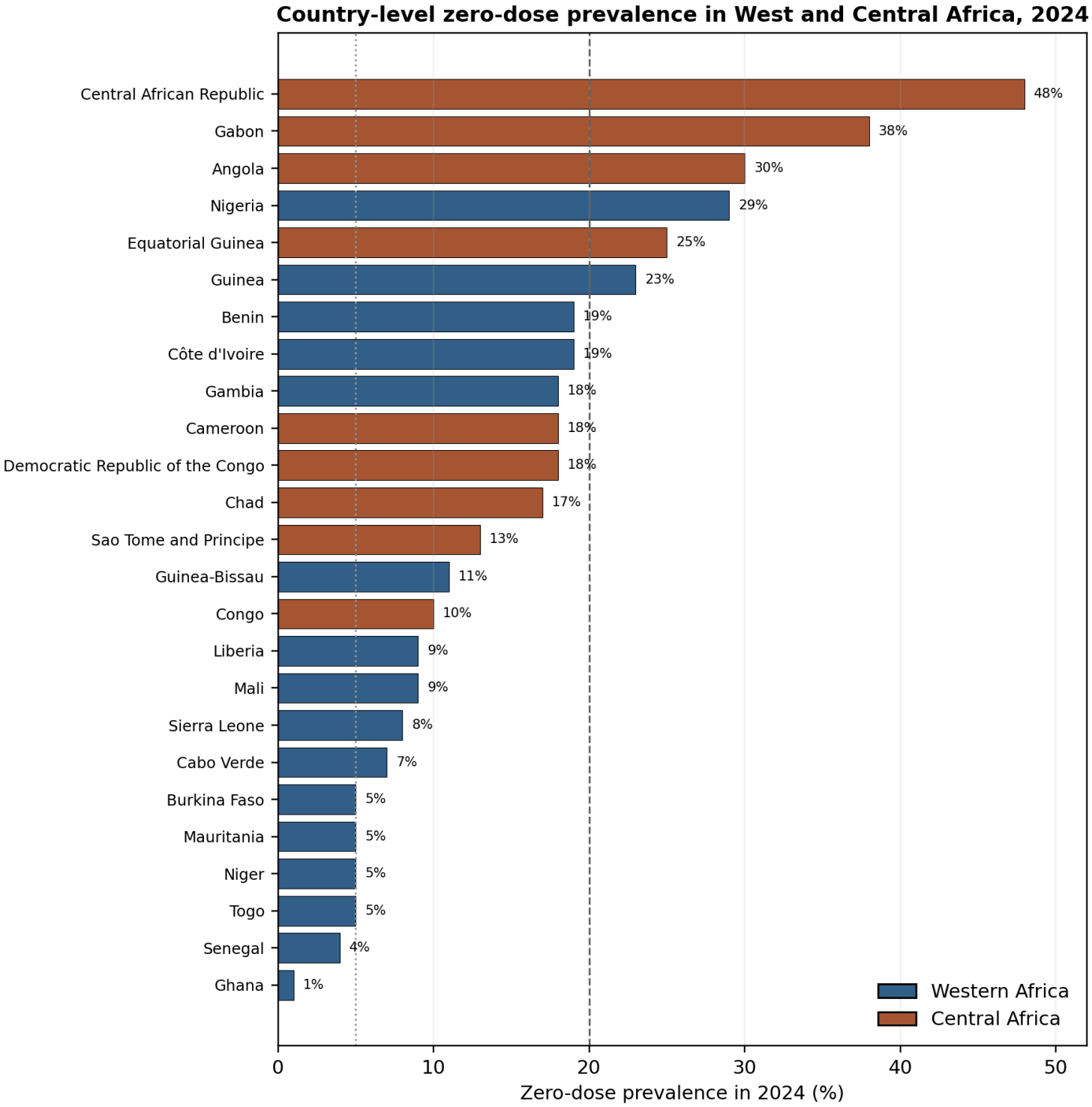


Figure 2

Country-level zero-dose prevalence in West and Central Africa, 2024, ranked from highest to lowest. Dashed reference line indicates 20%; dotted line indicates 5%.