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Article

Service Coverage Does Not Uniformly Translate into Financial Protection Under Universal Health Coverage: A Multicountry Panel Analysis, 2000-2023

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Highlights

Public health relevance

- A harmonized panel of 981 country-year observations from 159 countries linked UHC service coverage to financial hardship.
- Global service coverage improved substantially, but financial hardship remained socially and geographically unequal.

Public health significance

- Each 1-point increase in the service coverage index corresponded to a 0.441 percentage-point reduction in hardship in the two-way fixed-effects model.
- Wealth- and place-based hardship gradients remained large despite aggregate progress in service coverage.

Public health implications

- UHC monitoring should jointly track service coverage, financial protection, and inequality.
- Low-income settings may gain the greatest hardship reductions from service expansion when accompanied by pooled public financing.

Abstract

Universal health coverage (UHC) requires simultaneous gains in service coverage and financial protection, yet these dimensions are often analysed separately. We conducted a secondary ecological panel study using two public indicator files (UHC-SCI and UHC-FH40). Records were first harmonized through a document-oriented non-relational workflow that preserved irregular subgroup structures before flattening to a country-year panel. The analytic sample comprised 981 observations from 159 countries/economies between 2000 and 2023. We estimated pooled trends, correlations, country and two-way fixed-effects models with clustered standard errors, a random-intercept model, a generalized estimating equation, domain-specific models, wealth- and urbanization-based inequality metrics, beta-convergence models, and country typologies. Mean service coverage rose from 58.9 to 74.1, whereas mean financial hardship fell from 24.0% to 17.3%. Each 1-point increase in the service coverage index was associated with a 0.441 percentage-point reduction in hardship (95% CI: -0.707 to -0.175; $p = 0.001$). The mean poorest-richest and rural-urban hardship gaps were 53.7 and 12.5 percentage points. Low-income settings showed the steepest inequities and the strongest negative slope. UHC progress therefore remains incomplete unless service expansion, financial protection, and inequality monitoring are interpreted together.

Keywords: universal health coverage; financial risk protection; health equity; out-of-pocket expenditures; panel data; global health

1. Introduction

Universal health coverage (UHC) remains one of the central organizing goals of contemporary public health because it links access, protection, fairness, and state capacity. However, the policy and measurement history of UHC also shows a persistent analytical split between service delivery and financial protection. Recent syntheses emphasize that countries can expand contact with services without necessarily reducing the financial burden generated by out-of-pocket spending, particularly where pooling arrangements, primary care financing, and benefit package design remain incomplete [1–5].

This duality is not merely conceptual. The political economy of UHC depends on how systems mobilize, pool, allocate, and govern resources. Evidence from Asia, Africa, and other low- and middle-income settings suggests that gains in service coverage often coexist with vulnerability to catastrophic or impoverishing expenditure, especially for chronic care, medicines, and hospital episodes [6–10]. Accordingly, a country may appear to progress on essential service indicators while households continue to face severe financial hardship.

The tension is especially relevant in the post-pandemic context. UHC is increasingly discussed together with health security, resilience, and workforce adequacy because service continuity and financial protection are jointly tested during shocks. Studies from multiple regions have argued that stronger primary health care, sustained public financing, and resilient human resources for health are necessary to avoid reversals in both access and protection [7–10]. Yet comparable longitudinal analyses that link these two UHC components across countries are still limited.

A second challenge is inequality. Financial protection is rarely distributed evenly across wealth quintiles, territorial settings, age groups, or disability status. Even where national averages improve, the poorest groups and those living in rural or otherwise underserved areas may remain exposed to delayed care, debt, or medical impoverishment [11–15]. This means that average country performance can hide the very inequities that public health policy is meant to reduce.

The need for more integrated UHC analysis is reinforced by the growing number of domain-specific studies. Research has examined UHC financing reforms, disease burden, non-communicable disease coverage, maternal and child health, insurance expansion, and oral health inclusion, among other themes [11–18]. These strands are highly informative, but they often focus on one domain, one country, or one financing mechanism at a time. What remains comparatively underdeveloped is a multicountry empirical account of how changes in service coverage relate to changes in financial hardship over time and across stratified social groups.

Recent realist syntheses and policy priority exercises further show that UHC implementation is path-dependent and sensitive to governance design, institutional sequencing, and accountability arrangements [3,18–20]. For this reason, analytical frameworks need to capture heterogeneity rather than assume a single universal pathway. A country with high service coverage may still tolerate major hardship among poorer households, while another may show lower average coverage but faster progress in financial protection for vulnerable groups.

This study addresses that gap by integrating official UHC service coverage and financial hardship indicator files into a country-year panel that was first organized through a document-oriented non-relational (NoSQL) workflow and then analysed with standard statistical models. The objectives were to estimate whether higher service coverage is consistently associated with lower financial hardship, to quantify wealth- and place-based inequalities, and to identify cross-country typologies relevant for policy learning. We hypothesized that higher service coverage would be associated with lower hardship overall, but that the magnitude of this relationship would vary across continents and World Bank income groups and would coexist with persistent within-country inequality [1–5,19,20].

2. Materials and Methods

2.1. Study Design and Data Sources

We performed a secondary ecological analysis of publicly available UHC indicator data. Two public files from the WHO/World Bank UHC monitoring ecosystem were used: UHC-SCI.csv and UHC-FH40.csv. The SCI file contained 24,840 raw observations from 207 countries/economies for 2000-2023 and included the full UHC service coverage index plus four domain subindices. The FH40 file contained 17,634 raw observations from 180 countries/economies for 1985-2024 and included overall hardship plus subcomponents and disaggregation by wealth quintile and urbanization. Indicator definitions were aligned to the current WHO/World Bank monitoring framework and accompanying metadata [21–24].

2.2. NoSQL-Oriented Data Architecture

Because the source files mixed national observations with irregular subgroup dimensions, the preprocessing workflow first treated each record as a document-like unit keyed by country, year, indicator family, and stratifier. This document-oriented non-relational logic preserved nested combinations of domain, hardship subtype, wealth quintile, and urbanization without forcing premature flattening or loss of strata.

Three conceptual collections were then derived: one for SCI records (full index and domains), one for hardship records (overall hardship and subcomponents), and one for stratified hardship summaries (wealth quintiles and urbanization). Only after document-level validation of country-year completeness were these collections flattened into rectangular tables for statistical modelling. The NoSQL component therefore served as a transparent data-engineering step for reproducible aggregation rather than as the inferential framework itself.

2.3. Data Cleaning and Analytic Sample

For the overall panel, FH40 observations were restricted to all household types and total urbanization when country-level overall hardship was needed. Subcomponent series (large non-impoverishing burden, impoverishing expenditure, pushed into poverty, and further impoverished) were retained. SCI observations included the full index and the four reported domain subindices. After matching country-year observations across the two datasets and assigning continents, the harmonized analytic panel comprised 981 country-year observations from 159 countries/economies between 2000 and 2023. Countries with partial series were retained because the panel was unbalanced and the estimators selected are valid for unbalanced panels.

2.4. Variables

The primary exposure was the full SCI (0-100 scale). The primary outcome was overall financial hardship due to out-of-pocket spending, expressed as the percentage of the population experiencing hardship. Secondary outcomes were the four hardship subcomponents. To assess inequality, we derived the poorest-richest gap (Q1-Q5) from wealth-quintile records and the rural-urban gap from urbanization-stratified records. We also estimated a slope index of inequality (SII) from quintile-level hardship values using quintile midpoints as the ranked socioeconomic variable. For stratified policy interpretation, countries were grouped by continent and by World Bank income group.

2.5. External Country Stratification

To replace the internal SCI-derived resource proxy used in earlier drafts, countries were stratified using the most recent World Bank analytical income classification available in the Country Analytical History workbook [22]. This external stratifier was used only for descriptive and stratified analyses and not as an exposure variable. Two countries/economies in the analytic panel lacked a stable match and were excluded only from income-group-stratified summaries.

2.6. Statistical Analysis

The analysis had six layers. First, we described pooled global trends in SCI and overall hardship across the available years. Second, we estimated Pearson and Spearman correlations between SCI and hardship in the harmonized panel. Third, we fitted four main association models: a country fixed-effects model with a linear time trend, a two-way fixed-effects model with country and year indicators and cluster-robust standard errors at the country level, a random-intercept mixed model, and a generalized estimating equation with exchangeable working correlation. Fourth, we replaced the full SCI with its four domains in a two-way fixed-effects model to examine which domains were most strongly associated with hardship.

Fifth, we quantified inequality using poorest-richest and rural-urban gaps and by calculating a slope index of inequality (SII) from quintile-specific hardship values, with positive values indicating greater hardship among poorer quintiles. Sixth, we summarized latest available country values by continent and World Bank income group, estimated income-group-specific and continent-specific two-way fixed-effects slopes, tested beta-convergence in annual change, and derived country typologies using k-means clustering. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

2.7. Software, Reproducibility, and Ethical Considerations

Data processing and analysis were performed in Python using pandas, NumPy, SciPy, statsmodels, scikit-learn, and matplotlib. The harmonized panel, the World Bank income-group crosswalk used for stratified analyses, and the reproducible analysis script are supplied in the supplementary submission package. Data sources and analytic sample construction are summarized in Table 1, and the study used only aggregate public indicators without identifiable individual-level information.

Table 1. Data sources and analytic sample.

Dataset	Raw observations	Countries/economies in raw file	Time span	Analytic filters
UHC service coverage index (SCI)	24840	207	2000-2023	Full index and four domain subindices
Financial hardship (FH40)	17634	180	1985-2024	All household types, total urbanization for overall panel; hardship subcomponents retained
Harmonized analytic panel	981	159	2000-2023	Country-year overlap between SCI and FH, continent assigned, and World Bank income group matched where available

Note. The harmonized panel was produced after matching country-year observations across the two source files and applying the filters described in the Methods section.

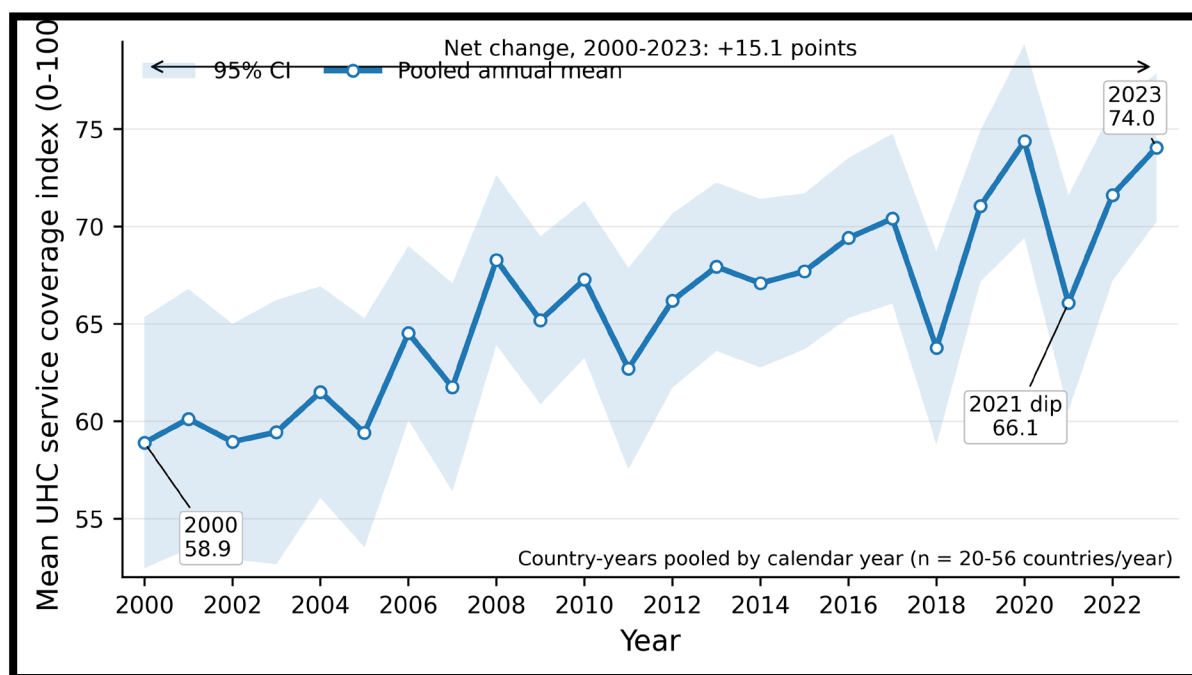
Table 2. Descriptive statistics for the harmonized panel.

Variable	Mean	SD	Median	IQR	Min	Max	N
SCI full index (0-100)	65.63	16.04	70.0	19.0	14.0	88.0	981
Financial hardship, all (%)	20.53	12.43	16.52	15.61	0.0	77.45	981
Large non-impoverishing OOP burden (%)	3.67	2.47	3.11	3.16	0.0	15.85	959
Impoverishing OOP expenditure (%)	16.85	11.87	12.45	14.49	0.0	73.89	959
Pushed into poverty (%)	1.7	1.19	1.42	1.21	0.0	9.53	885
Further impoverished (%)	15.45	11.75	10.84	13.75	0.2	72.36	885

3. Results

3.1. Global Trends in Service Coverage and Financial Hardship

The harmonized analytic panel contained 981 country-year observations from 159 countries/economies (Table 1). The mean SCI across the panel was 65.63 (SD 16.04), and mean overall financial hardship was 20.53% (SD 12.43), as summarized in Table 2. Pooled annual means indicate that SCI rose from 58.9 in 2000 to 74.0 in 2023, whereas overall hardship declined from 24.0% to 17.3% over the same period. The decline in hardship was therefore directionally favourable but markedly slower than the growth observed for service coverage, as shown in Figure 1 and Figure 2.

**Figure 1.** Pooled global mean UHC service coverage index (SCI), 2000–2023.

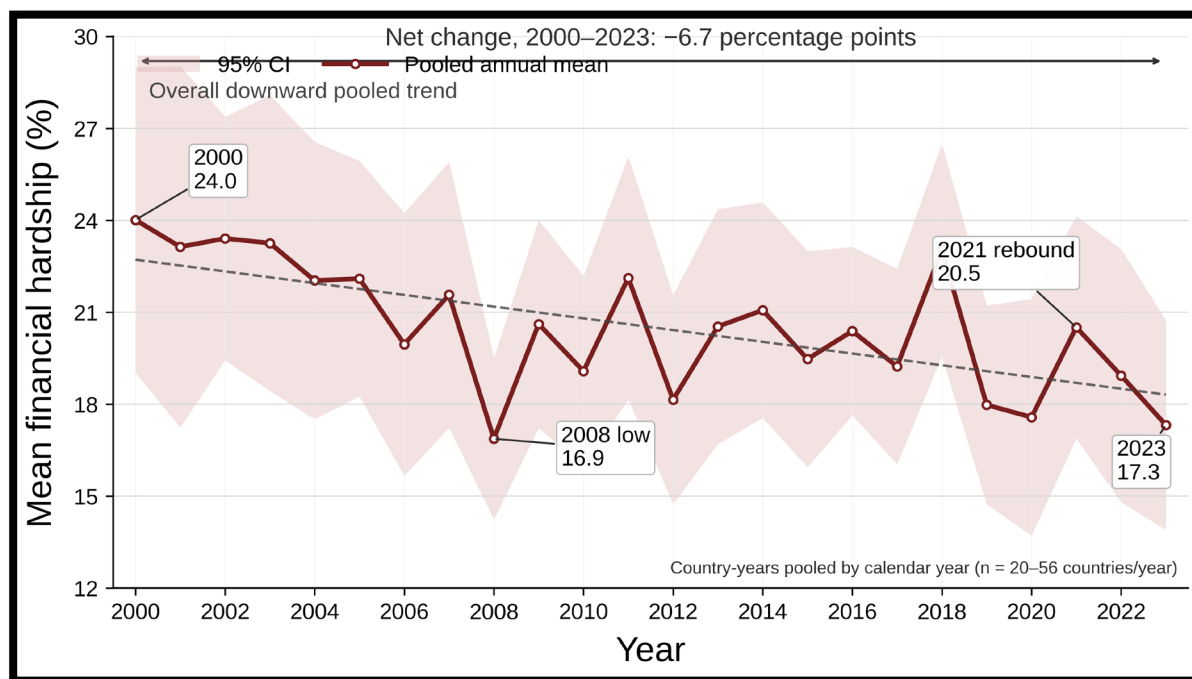


Figure 2. Pooled global mean overall financial hardship due to out-of-pocket health spending, 2000–2023.

3.2. Main Association Between Service Coverage and Financial Hardship

The bivariate relationship between SCI and overall financial hardship was strongly inverse (Pearson $r = -0.722$; $p < 0.001$; Spearman $\rho = -0.622$; $p < 0.001$). In the country fixed-effects model with a linear time trend, each one-point increase in SCI was associated with a -0.447 percentage-point change in hardship (95% CI: -0.691 to -0.203 ; $p = 0.0003$). The estimate remained very similar in the two-way fixed-effects model (-0.441 ; 95% CI: -0.707 to -0.175 ; $p = 0.0011$), in the random-intercept mixed model (-0.496 ; $p < 0.001$), and in the GEE model (-0.521 ; $p < 0.001$). Taken together, these models indicate a robust negative association between service coverage and hardship at the country-year level (Table 3), while the overall inverse bivariate pattern is visualized in Figure 3.

Table 3. Main association models linking SCI to overall financial hardship.

Model	Beta	CI low	CI high	p-value	N	R2
Pearson correlation	-0.722	—	—	<0.001	981	0.521
Country FE + trend	-0.447	-0.691	-0.203	0.0003	981	0.886
Two-way FE	-0.441	-0.707	-0.175	0.0011	981	0.889
Mixed model	-0.496	-0.564	-0.429	<0.001	981	—
GEE	-0.521	-0.599	-0.443	<0.001	981	—
Spline test	—	—	—	0.0618	981	0.890

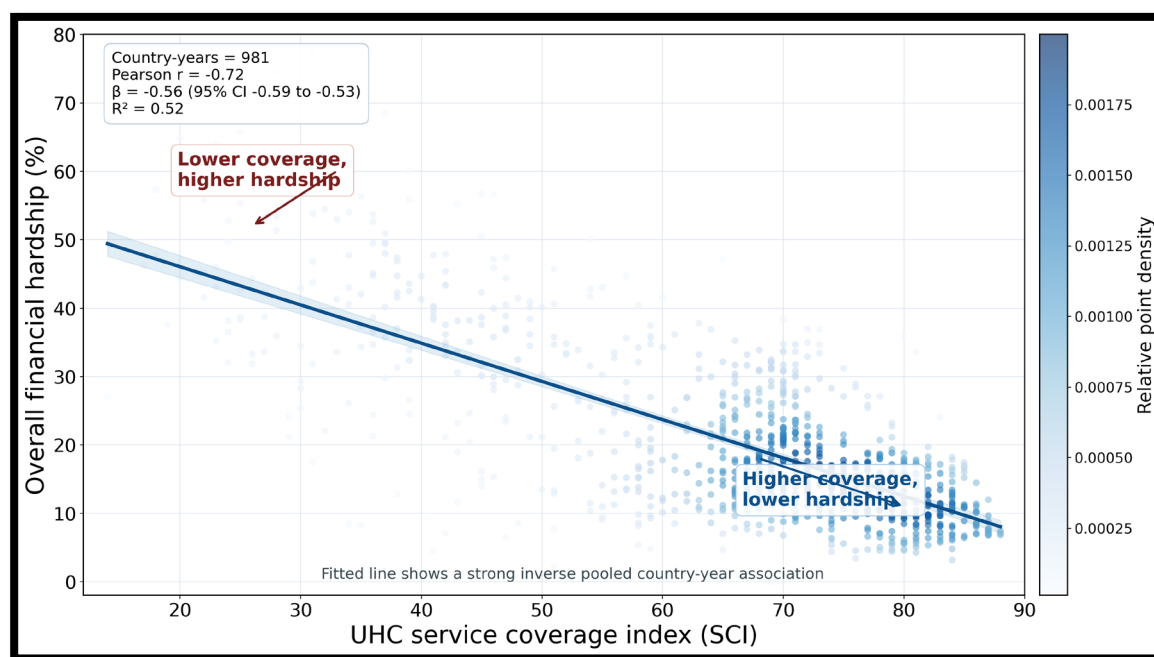


Figure 3. Scatterplot of SCI and overall financial hardship with fitted linear trend.

3.3. Domain-Specific Associations

When the full SCI was decomposed into its four component domains within a two-way fixed-effects specification, the strongest inverse associations with hardship were observed for the infectious diseases subindex and the non-communicable diseases subindex. The infectious diseases domain was associated with a -0.206 percentage-point change in hardship per point increase ($p = 0.0019$), and the non-communicable diseases domain with a -0.257 percentage-point change ($p = 0.0437$). The RMNCH domain and the service capacity and access domain showed negative but less stable or non-significant associations after full adjustment. This suggests that not all service-coverage components translate equally into household financial protection (Table 4).

Table 4. Domain-specific two-way fixed-effects model.

SCI domain	Beta	CI low	CI high	p-value
RMNCH subindex	0.12	-0.133	0.373	0.3521
Infectious diseases subindex	-0.206	-0.336	-0.076	0.0019
Non-communicable diseases subindex	-0.257	-0.506	-0.007	0.0437
Service capacity and access subindex	-0.076	-0.172	0.019	0.1158

3.4. Inequalities by Wealth Quintile and Urbanization

Marked inequalities were observed across socioeconomic and territorial strata, as summarized in Table 5 and visualized in Figure 4. The mean poorest-richest gap (Q1-Q5) in hardship was 53.7 percentage points, while the mean rural-urban gap was 12.5 percentage points. In other words, the burden of financial hardship was substantially concentrated among poorer and rural populations

wherever disaggregated data were available. The latest available SII summaries reinforced this pattern: mean SII values were highest in low-income countries (68.85) and lower in high-income countries (35.73), while Africa remained the continent with the steepest average wealth gradient (Tables 5A and 5B).

Table 5. Summary inequality metrics derived from wealth- and urbanization-stratified hardship data.

Metric	Mean	SD	Median	IQR	Min	Max	N
Poorest-richest gap in financial hardship (Q1-Q5)	53.73	21.40	53.81	31.57	-28.91	99.75	1323
Rural-urban gap in financial hardship	12.50	12.02	9.88	14.90	-34.30	53.23	783

Note. Q1–Q5 denotes the difference between the poorest and richest wealth quintiles. SII summaries are provided below as complementary indicators of the socioeconomic gradient.

Table 5. A. Latest available slope index of inequality (SII) by continent.

Continent	Countries	Mean SII	Median SII
Africa	49	66.93	70.59
Americas	26	45.94	49.71
Asia	34	56.5	59.17
Europe	36	36.8	38.81
Oceania	11	20.36	20.49

Table 5. B. Latest available slope index of inequality (SII) by World Bank income group.

Income group	Countries	Mean SII	Median SII
High income	44	35.73	35.38
Upper-middle income	45	46.51	43.38
Lower-middle income	48	60.13	70.14
Low income	24	68.85	70.29

Note. Country counts in Tables 5A and 5B reflect countries with latest available quintile-specific hardship data sufficient to compute the slope index of inequality and therefore differ from totals shown in Tables 6 and 7.

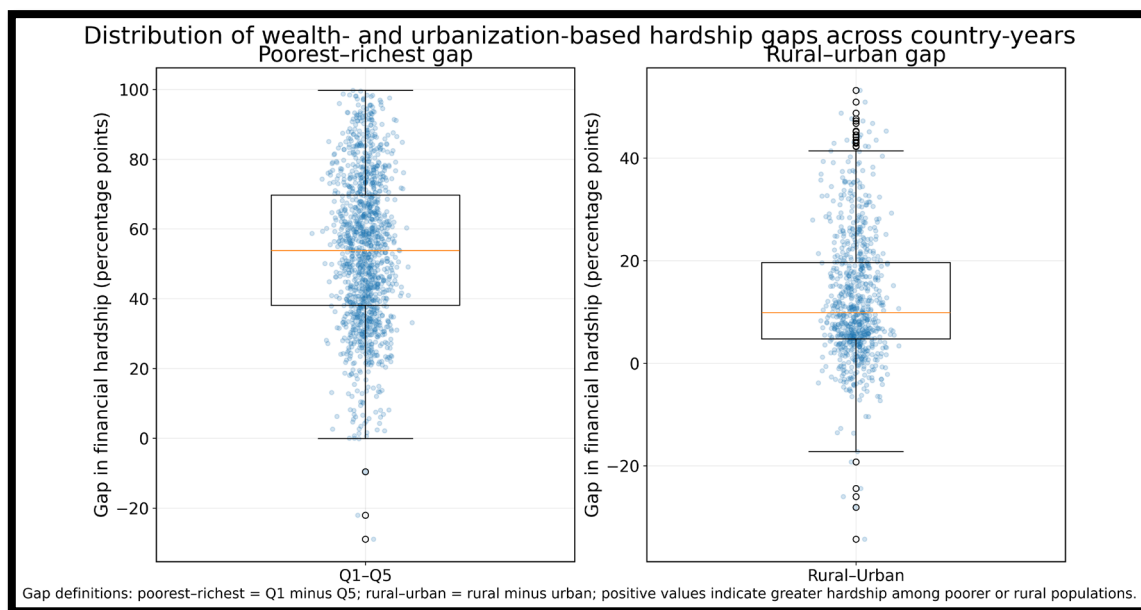


Figure 4. Distribution of wealth- and urbanization-based hardship gaps across country-years.

3.5. Cross-Sectional Heterogeneity in Latest Available Values

Using the latest available country observation, large continental differences were evident (Table 6; Figure 5). Europe showed the highest mean SCI (77.94) and comparatively low hardship (11.57%), whereas Africa showed the lowest mean SCI (49.06) and the highest hardship (31.29%). The Kruskal-Wallis test confirmed significant between-continent differences for both SCI ($p = 1.05e-17$) and hardship ($p = 3.37e-15$). When countries were grouped by World Bank income group, hardship was progressively lower from low-income to high-income settings: mean hardship was 36.36% in low-income countries and 11.49% in high-income countries, while mean SCI increased from 42.21 to 80.05 (Table 7).

Table 6. Latest available SCI and hardship by continent.

Continent	Countries	SCI mean	SCI median	FH mean	FH median
Africa	49	49.06	47.0	31.29	32.44
Oceania	11	60.45	62.0	5.96	5.38
Asia	36	68.08	69.5	21.25	22.16
Americas	27	74.48	77.0	17.51	15.91
Europe	36	77.94	77.5	11.57	11.38

Note. Between-continent Kruskal-Wallis p-values: SCI $p = 1.05e-17$; hardship $p = 3.37e-15$.

Table 7. Latest available SCI and hardship by World Bank income group.

Income group	Countries	SCI mean	SCI median	FH mean	FH median
High income	41	80.05	81.00	11.49	11.00
Upper-middle income	45	71.64	71.00	16.83	14.64

Income group	Countries	SCI mean	SCI median	FH mean	FH median
Lower-middle income	47	56.91	56.00	24.39	26.02
Low income	24	42.21	42.00	36.36	36.02

Note. Between-income-group Kruskal-Wallis p-values: SCI $p = 3.79e-23$; hardship $p = 9.68e-14$. Income group reflects the most recent World Bank analytical classification matched to each country; group totals sum to 157 because two countries/economies in the analytic panel lacked a stable World Bank income-group match.

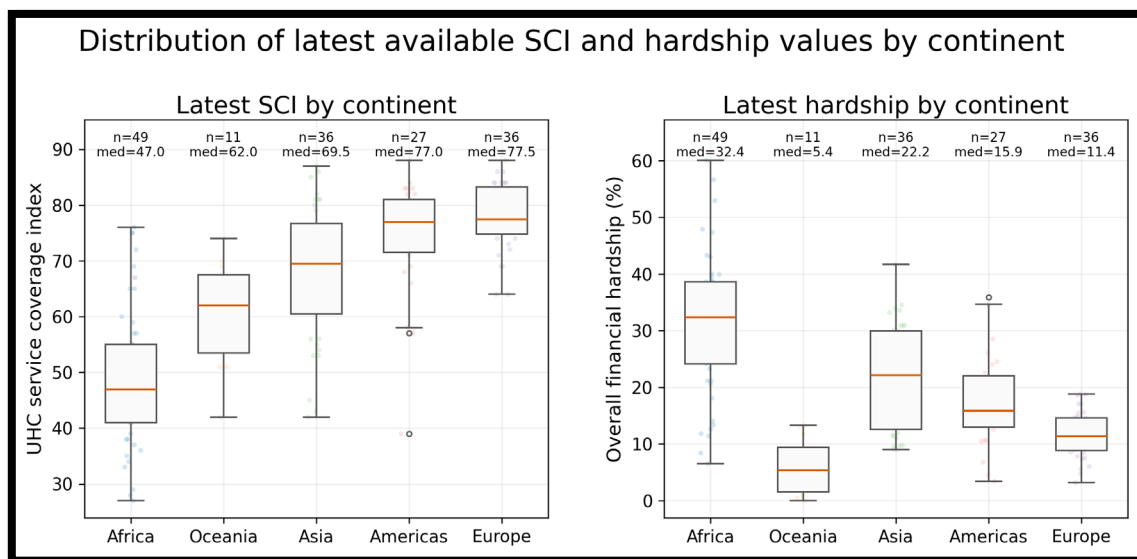


Figure 5. Distribution of latest available SCI and hardship values by continent.

3.6. Stratified Slopes, Convergence, and Country Typologies

The strength of the SCI-hardship association was not uniform across geopolitical or income strata. In continent-specific two-way fixed-effects models, the inverse association was strongest in Africa (beta = -0.495; $p = 0.0006$) and was weaker or statistically unstable in other continental groupings. In income-group-specific models, the association was strongest and clearly significant in low-income countries (beta = -1.002; $p = 0.0035$), whereas it was attenuated and statistically uncertain in upper-middle-income and high-income groups (Tables A1 and A2). This suggests that marginal gains in service coverage may translate into larger hardship reductions where baseline deficits are greatest.

Table A1. Continent-specific SCI-hardship slopes from stratified two-way fixed-effects models.

Continent	Beta	CI low	CI high	p-value
Africa	-0.495	-0.779	-0.211	0.0006
Americas	-0.223	-0.741	0.294	0.3977
Asia	-0.333	-0.675	0.009	0.0567
Europe	-0.175	-0.689	0.339	0.5047
Oceania	0.062	-0.298	0.422	0.7344

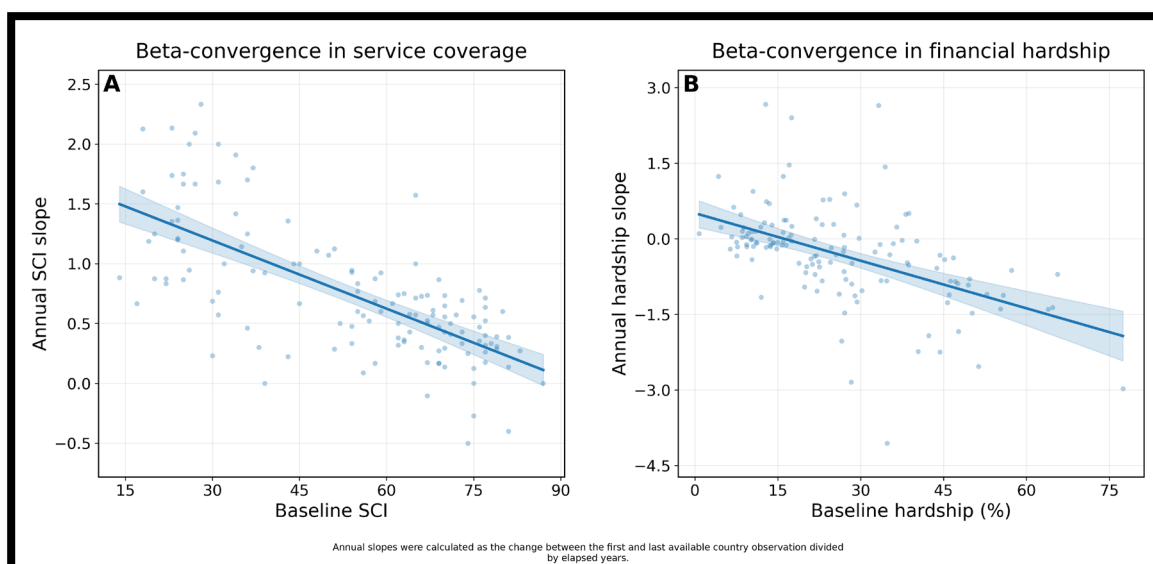
Table A2. Income-group-specific SCI-hardship slopes from stratified two-way fixed-effects models.

Income group	Beta	CI low	CI high	p-value
High income	-0.021	-0.383	0.341	0.9090
Upper-middle income	-0.336	-0.856	0.184	0.2059
Lower-middle income	-0.295	-0.968	0.379	0.3911
Low income	-1.002	-1.673	-0.330	0.0035

Convergence analysis showed that countries with lower baseline SCI improved faster over time (baseline coefficient = -0.019; $p < 0.001$), and countries with worse baseline hardship also changed more rapidly (baseline coefficient = -0.031; $p < 0.001$), as shown in Table A3 and Figure 6. Although this is encouraging, convergence did not eliminate substantive between-country inequality because country clusters still displayed very different endpoint combinations of coverage, hardship, and distributional gaps.

Table A3. Beta-convergence models.

Outcome	Baseline coefficient	CI low	CI high	p-value	R2
SCI annual slope	-0.019	-0.022	-0.016	<0.001	0.487
FH annual slope	-0.031	-0.041	-0.022	<0.001	0.260

**Figure 6.** Convergence patterns linking baseline values to within-country annual slopes.

K-means clustering identified four policy-relevant country profiles. Cluster A combined relatively high final coverage with low hardship; Cluster B captured lower-coverage countries with rapid improvement but still high inequality; Cluster C represented a small fragile group with worsening hardship; and Cluster D included countries with mid-to-high coverage but persistent

inequality. The presence of these distinct profiles reinforces the idea that average global progress masks heterogeneous pathways (Table A4 and Figure 7).

Table A4. Country typology from clustering.

Cluster	Profile	Counties	SCI (latest)	FH all (latest)	SCI annual slope	FH annual slope	Mean Q1-Q5 gap
A	High coverage; low hardship	53	73.81	11.90	0.54	-0.08	36.40
B	Low coverage; rapid gains; high inequality	35	46.14	34.37	1.37	-0.91	65.65
C	Fragile; rising hardship	6	37.33	37.90	0.63	1.79	33.91
D	Mid-high coverage; persistent inequality	37	70.92	22.57	0.48	-0.40	67.87

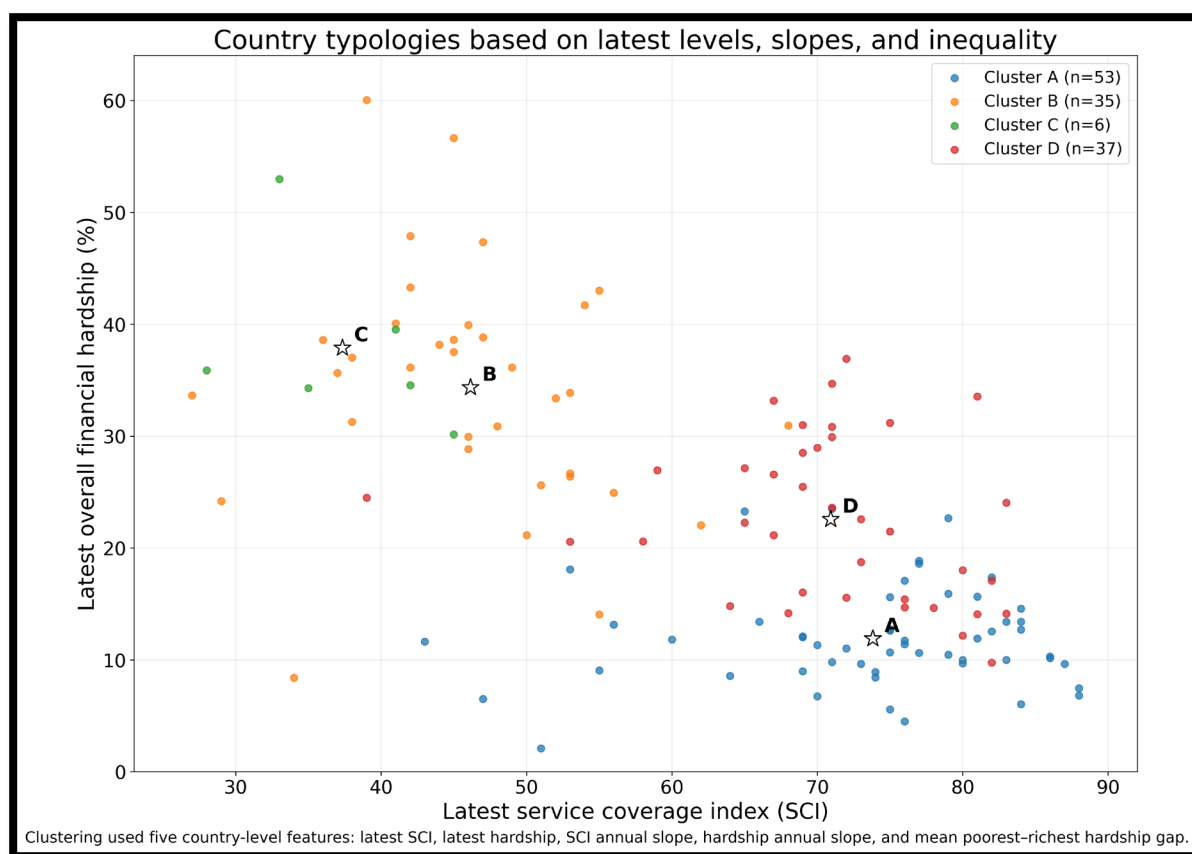


Figure 7. Country typologies derived from service coverage, hardship, slopes, and inequality features.

At the country level, the latest available highest SCI values were observed in the United States and the United Kingdom (both 88), followed by the Republic of Korea (87) and several European high-income systems. The highest hardship burdens were concentrated in African countries, led by

the Democratic Republic of the Congo (60.03%), Burundi (56.64%), and the Central African Republic (52.97%) (Tables A5 and A6).

Table A5. Countries with the highest latest SCI values.

Country	Continent	SCI (latest)	FH all (latest)
United States	Americas	88.0	6.81
United Kingdom	Europe	88.0	7.47
Korea, Rep.	Asia	87.0	9.65
Finland	Europe	86.0	10.15
Switzerland	Europe	86.0	10.31
Japan	Asia	86.0	11.0
Israel	Asia	85.0	16.57
Netherlands	Europe	84.0	3.17
Germany	Europe	84.0	4.8
Slovenia	Europe	84.0	6.05

Table A6. Countries with the highest latest hardship values.

Country	Continent	SCI (latest)	FH all (latest)
Congo, Dem. Rep.	Africa	39.0	60.03
Burundi	Africa	45.0	56.64
Central African Republic	Africa	33.0	52.97
Sierra Leone	Africa	42.0	47.89
Nigeria	Africa	47.0	47.35
Liberia	Africa	42.0	43.29
Malawi	Africa	55.0	43.02
Bangladesh	Asia	54.0	41.7
Mali	Africa	41.0	40.07
Sudan	Africa	46.0	39.92

4. Discussion

The central finding of this study is that service coverage and financial protection move in the same desirable direction at the global level, but they do not move together tightly enough to justify using one as a proxy for the other. Across 159 countries/economies and 981 country-year observations, higher SCI was consistently associated with lower hardship, yet the magnitude of the relationship varied markedly across contexts and remained compatible with very large socioeconomic gaps. This overarching pattern is visible in the pooled time trends (Figure 1 and Figure 2) and in the country-year association analyses (Table 3 and Figure 3). It is also consistent with regional evidence showing that national UHC progress often coexists with persistent exposure to financial burden for specific subpopulations [25–27].

Our results also strengthen the argument that financial protection is not simply a downstream by-product of broader service expansion. The negative association between SCI and hardship remained robust across fixed-effects, mixed-model, and GEE specifications (Table 3), but the size of the coefficient was far from sufficient to erase the average 53.7 percentage-point poorest-richest gap observed in the hardship data (Table 5). This mirrors recent findings from Thailand, Kenya, Georgia,

and East Asian comparative work showing that coverage design, cost sharing, pooling depth, and benefit structure mediate whether service use becomes financially safe or financially punitive [28–31].

The inequality findings are arguably the most policy-relevant. Wealth- and place-based gradients were steep, and SII values were highest in Africa and among low-income and lower-middle-income countries (Table 5, Table 5A, Table 5B, and Figure 4). These results align with recent studies from Indonesia, Malaysia, Mexico, and Vietnam showing that financial protection remains socially patterned even under nominally universal arrangements, especially for lower-income households, people with disability, and groups facing chronic care needs [32–36]. In practical terms, the present analysis suggests that monitoring only national UHC averages can conceal the very inequities that should trigger corrective financing action.

The domain-specific results merit attention. Infectious-disease and non-communicable disease service domains were more strongly associated with hardship reductions than the RMNCH and service-capacity subindices after full adjustment (Table 4). One plausible interpretation is that domains closely linked to recurrent treatment costs, medicines, and long-term disease management may more directly shape household exposure to out-of-pocket spending. This interpretation is compatible with evidence that financial protection is particularly sensitive to chronic illness, ageing-related service needs, and fragmented coverage for ambulatory and pharmaceutical care [27,33,37].

The convergence analyses offer cautious optimism. Countries starting from poorer baseline positions improved faster on average, both for SCI and hardship (Table A3 and Figure 6). This is consistent with recent global and South Asian evidence suggesting that lagging countries can still make substantial gains within a decade when financing reforms, public purchasing, and service expansion are aligned [37,38]. At the same time, the cluster analysis shows that convergence is incomplete: some countries remain trapped in combinations of moderate coverage, high hardship, and severe inequality, while a small fragile group appears to face worsening hardship despite low-to-moderate service coverage (Table A4 and Figure 7).

For policy, the findings support a differentiated approach rather than a single template. High-income countries with residual hardship should focus on medicines, chronic care affordability, and equity-sensitive benefit design. Upper-middle-income and lower-middle-income countries may need simultaneous strengthening of primary care, public purchasing, and explicit redesign of financial protection instruments. Low-income countries, especially in Africa, appear most likely to gain hardship reductions from additional service-coverage progress, but only if that progress is financed through pooled and publicly accountable mechanisms rather than increased household spending. This reading is consistent with the cross-continental and income-group-stratified summaries presented in Tables 6, 7, A1, and A2, and with the growing literature calling for primary-health-care-centred UHC, stronger accountability, and explicit equity protection [29–31,38,39].

4.1. Strengths and Limitations

This study has several strengths. It integrates two major public UHC datasets, uses a document-oriented architecture suited to irregular stratified indicator data, reports multiple complementary models, and extends the analysis beyond national averages to wealth- and place-based inequality. The organization of the data sources (Table 1), the descriptive profile of the harmonized panel (Table 2), the main inferential models (Table 3), and the inequality summaries (Table 5) support this breadth, while machine-readable supplementary tables, the harmonized panel, and the reproducible analysis script strengthen transparency. Several limitations should be acknowledged. First, the design is ecological and cannot establish individual-level mechanisms or causal effects. Second, the panel is unbalanced. Third, country-level hardship data are derived from official monitoring systems whose underlying survey and estimation procedures vary over time. Fourth, World Bank income groups were used as external descriptive strata and do not fully capture fiscal space, pooling depth, or benefit design; two countries/economies lacked a stable match and were excluded from income-group-

stratified summaries. Finally, because the source files are pre-aggregated indicators, we could not model within-country household covariates directly.

5. Conclusions

This multicountry analysis shows that UHC progress is real but uneven. Higher service coverage is associated with lower financial hardship, yet the translation from coverage to protection is incomplete and socially unequal. The most affected gradients remain concentrated among poorer and rural populations, and the relationship between coverage and hardship is strongest where resource constraints are greatest. For global health policy, the implication is clear: countries should not treat SCI gains as sufficient evidence of equitable UHC achievement.

Internationally, monitoring frameworks should combine service coverage, hardship subcomponents, and inequality metrics in the same dashboard. High-income countries should concentrate on the affordability gaps that persist despite otherwise strong service systems; upper-middle-income and lower-middle-income countries should align service expansion with deeper risk pooling and more coherent benefit packages; and low-income countries require simultaneous investment in primary care, public financing, and pro-poor protection against out-of-pocket shocks. Continent-specific strategies are also warranted, particularly for African settings where both hardship burdens and socioeconomic gradients remain highest. A document-oriented data architecture can facilitate this agenda by supporting repeated aggregation, subgroup retention, and transparent longitudinal monitoring across heterogeneous country-year records.

Supplementary Materials: Supplementary Files S1-S3 include the reproducible Python analysis script, the harmonized country-year panel with the income-group crosswalk used for stratified analyses, and the machine-readable supplementary tables and figures submitted with this manuscript.

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Data Availability Statement: The original UHC indicator files used in this study are publicly available from the WHO/World Bank UHC monitoring ecosystem. For peer review, the harmonized analytic panel, the World Bank income-group crosswalk, and the reproducible analysis script are provided as Supplementary Files S1-S3 with this submission.

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Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
AI	artificial intelligence	CI	confidence interval
CICV	Centro de Investigaciones en Ciencias de la Vida	CSV	comma-separated values
OOP	out-of-pocket	FH	financial hardship

FH40	financial hardship due to out-of-pocket health spending	GEE	generalized estimating equations
95% CI	95% confidence interval	WB	World Bank
JSON	JavaScript Object Notation	NoSQL	non-relational, document-oriented data architecture
ORCID	Open Researcher and Contributor ID	PNG	Portable Network Graphics
Q1	poorest wealth quintile	Q5	richest wealth quintile
RMNCH	reproductive, maternal, newborn, and child health	SCI	service coverage index
SD	standard deviation	SDG	Sustainable Development Goal
UHC	universal health coverage	WHO	World Health Organization

References

1. Darrudi A, Khoonsari MHK, Tajvar M. Challenges to achieving universal health coverage throughout the world: a systematic review. *J Prev Med Public Health*. 2022;55(2):125–133. <https://doi.org/10.3961/jpmph.21.542>.
2. Ranabhat CL, Acharya SP, Adhikari C, Kim C-B. Universal health coverage evolution, ongoing trend, and future challenge: a conceptual and historical policy review. *Front Public Health*. 2023;11:1041459. <https://doi.org/10.3389/fpubh.2023.1041459>.
3. Endalamaw A, Mengistu TS, Khatri RB, et al. Universal health coverage—exploring the what, how, and why using realist review. *PLOS Glob Public Health*. 2025;5(3):e0003330. <https://doi.org/10.1371/journal.pgph.0003330>.
4. World Health Organization. Universal health coverage (UHC). Available online: <https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-%28uhc%29> (accessed on 14 March 2026).
5. World Health Organization; World Bank. Tracking universal health coverage: 2025 global monitoring report; World Health Organization: Geneva, Switzerland, 2025. Available online: <https://www.who.int/publications/i/item/9789240117808> (accessed on 14 March 2026).
6. Takura T, Miura H. Socioeconomic determinants of universal health coverage in the Asian region. *Int J Environ Res Public Health*. 2022;19(4):2376. <https://doi.org/10.3390/ijerph19042376>.
7. Hanson K, Briki N, Erlangga D, et al. The Lancet Global Health Commission on financing primary health care: putting people at the centre. *Lancet Glob Health*. 2022;10(5):e715–e772. [https://doi.org/10.1016/S2214-109X\(22\)00005-5](https://doi.org/10.1016/S2214-109X(22)00005-5).
8. Lal A, Erondy NA, Heymann DL, Gitahi G, Yates R. Pandemic preparedness and response: exploring the role of universal health coverage within the global health security architecture. *Lancet Glob Health*. 2022;10(11):e1675–e1683. [https://doi.org/10.1016/S2214-109X\(22\)00341-2](https://doi.org/10.1016/S2214-109X(22)00341-2).
9. Dhillon I, Jhalani M, Thamarangsi T, Siyam A, Khetrpal Singh P. Advancing universal health coverage in the WHO South-East Asia Region with a focus on human resources for health. *Lancet Reg Health Southeast Asia*. 2023;18:100313. <https://doi.org/10.1016/j.lansea.2023.100313>.
10. Lai Y, Liang D, Bobogare A, Yadamsuren B, Yam E, Yi S, Bugoro H, Huang J. Synergising universal health coverage and global health security in the Western Pacific Region. *J Glob Health*. 2025;15:04037. <https://doi.org/10.7189/JOGH.15.04037>.
11. Hajjar K, Moresky RT, et al. Association between universal health coverage and the disease burden of acute illness and injury at the global level. *BMC Public Health*. 2023;23:735. <https://doi.org/10.1186/s12889-023-15671-2>.

12. Khan MR, Mohammad KU, Rabbani MS. Impact of health expenditure on universal health coverage (composite index): global evidence. *Health Promot Perspect.* 2025;15(3):268–277. <https://doi.org/10.34172/hpp.2025.025>.
13. Arhin K, Frimpong AO, Acheampong K. Effect of primary health care expenditure on universal health coverage: evidence from Sub-Saharan Africa. *Clinicoecon Outcomes Res.* 2022;14:643–652. <https://doi.org/10.2147/CEOR.S380900>.
14. Fisher M, Freeman T, Mackean T, Friel S, Baum F. Universal health coverage for non-communicable diseases and health equity: lessons from Australian primary healthcare. *Int J Health Policy Manag.* 2022;11(5):690–700. <https://doi.org/10.34172/ijhpm.2020.232>.
15. Feng XL, Zhang Y, Hu X, et al. Tracking progress towards universal health coverage for essential health services in China, 2008–2018. *BMJ Glob Health.* 2022;7(11):e010552. <https://doi.org/10.1136/bmjgh-2022-010552>.
16. Bayked EM, Toleha HN, Kebede SZ, Workneh BD, Kahissay MH. The impact of community-based health insurance on universal health coverage in Ethiopia: a systematic review and meta-analysis. *Glob Health Action.* 2023;16(1):2189764. <https://doi.org/10.1080/16549716.2023.2189764>.
17. Winkelmann J, Listl S, van Ginneken E, Benzian H. Universal health coverage cannot be universal without oral health. *Lancet Public Health.* 2023;8(1):e8–e10. [https://doi.org/10.1016/S2468-2667\(22\)00315-2](https://doi.org/10.1016/S2468-2667(22)00315-2).
18. Hajji O, El Abbadi B, Akhnif EH, et al. Systematic review of financing functions for universal health coverage in low- and middle-income countries: reforms, challenges, and lessons learned. *Public Health Rev.* 2025;46:1607745. <https://doi.org/10.3389/phrs.2025.1607745>.
19. Langat E, Gesesew HA, Mwanri L, Ward PR. Factors influencing the adoption of universal health coverage in Africa: insights from a realist synthesis. *Soc Sci Med.* 2025;387:118709. <https://doi.org/10.1016/j.socscimed.2025.118709>.
20. Namyalo PK, Wodnik BK, Michaelides O, Kane S, Essue B, Di Ruggiero E. Identifying implementation science research and policy priorities to advance universal health coverage: a multi-country modified Delphi study. *BMJ Glob Health.* 2025;10(8):e018562. <https://doi.org/10.1136/bmjgh-2024-018562>.
21. World Health Organization. Financial hardship in health and components (SDG 3.8.2, 2025 definition), % of the population. Available online: <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/376> (accessed on 14 March 2026).
22. World Bank Data Help Desk. How does the World Bank classify countries? Available online: <https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries> (accessed on 14 March 2026).
23. World Bank. Universal health coverage (UHC) service coverage index. Data360. Available online: <https://data360.worldbank.org/en/indicator/UHC-SCI> (accessed on 14 March 2026).
24. World Bank. Universal health coverage (UHC) dataset. Data360. Available online: https://data360.worldbank.org/en/dataset/WB_UHC (accessed on 14 March 2026).
25. Thomson S, Cylus J, Evetovits T, et al. Monitoring progress towards universal health coverage in Europe: a descriptive analysis of financial protection in 40 countries. *Lancet Reg Health Eur.* 2024;37:100826. <https://doi.org/10.1016/j.lanepe.2023.100826>.
26. Antunes AF, Jithitikulchai T, Hohmann J, Flessa S. Revisiting a decade of inequality in healthcare financial burden in Cambodia, 2009–19: trends, determinants and decomposition. *Int J Equity Health.* 2024;23:196. <https://doi.org/10.1186/s12939-024-02257-6>.
27. Okamoto S, Sata M, Rosenberg M, et al. Universal health coverage in the context of population ageing: catastrophic health expenditure and unmet need for healthcare. *Health Econ Rev.* 2024;14:8. <https://doi.org/10.1186/s13561-023-00475-2>.
28. Damrongplisit K, Melnick G. Utilisation, out-of-pocket payments and access before and after COVID-19: Thailand’s universal health coverage scheme. *BMJ Glob Health.* 2024;9(5):e015179. <https://doi.org/10.1136/bmjgh-2024-015179>.
29. Nungo S, Filippon J, Russo G. Social health insurance for universal health coverage in low- and middle-income countries: a retrospective policy analysis of attainments, setbacks and equity implications of

- Kenya's social health insurance model. *BMJ Open*. 2024;14(12):e085903. <https://doi.org/10.1136/bmjopen-2024-085903>.
30. Gorgodze T, et al. Financial protection and universal health coverage in Georgia: an analysis of impoverishing healthcare costs using household income and expenditure surveys. *BMJ Glob Health*. 2025;10(7):e019150. <https://doi.org/10.1136/bmjgh-2025-019150>.
 31. Zhang Q, Wang JSH, He AJ, et al. Providing financial protection in health for low-income populations: a comparison of health financing designs in East Asia. *Int J Equity Health*. 2025;24:215. <https://doi.org/10.1186/s12939-025-02568-2>.
 32. Azizatunnisa' L, Probandari A, Kuper H, Banks LM. Health insurance coverage, healthcare use, and financial protection amongst people with disabilities in Indonesia: analysis of the 2021 National Socioeconomic Survey. *Lancet Reg Health Southeast Asia*. 2025;39:100631. <https://doi.org/10.1016/j.lansea.2025.100631>.
 33. Hussein N, Ng CW, Ramli R, et al. Assessing catastrophic health expenditure and impoverishment in adult asthma care: a cross-sectional study of patients attending six public health clinics in Klang District, Malaysia. *BMC Health Serv Res*. 2024;24:327. <https://doi.org/10.1186/s12913-024-10731-8>.
 34. Serván-Mori E, Gómez-Dantés O, et al. Increase of catastrophic and impoverishing health expenditures in Mexico associated to policy changes and the COVID-19 pandemic. *J Glob Health*. 2023;13:06044. <https://doi.org/10.7189/jogh.13.06044>.
 35. Cerecero-García D, Gómez-Dantés O, Hone T, et al. Catastrophic and impoverishing health expenditures in fragmented public health systems: lessons from Mexico, 2000–2022. *Health Econ Rev*. 2026;16:22. <https://doi.org/10.1186/s13561-026-00717-z>.
 36. Nguyen PT, Le PM. Progress and inequalities in financial risk protection toward universal health coverage: insights from Vietnam. *Int J Equity Health*. 2025;24:287. <https://doi.org/10.1186/s12939-025-02659-0>.
 37. Rahman MM, Jung J, Islam MR, et al. Global, regional, and national progress in financial risk protection towards universal health coverage, 2000–2030. *Soc Sci Med*. 2022;312:115367. <https://doi.org/10.1016/j.socscimed.2022.115367>.
 38. Rahman MM, et al. Progress towards universal health coverage in South Asia, 2000–2030: an examination of the twin elements of primary healthcare provision and financial protection. *BMJ Glob Health*. 2025;10(11):e020052. <https://doi.org/10.1136/bmjgh-2025-020052>.
 39. The Lancet Regional Health—Europe. Strengthening primary health care to achieve universal health coverage. *Lancet Reg Health Eur*. 2024;39:100897. <https://doi.org/10.1016/j.lanep.2024.100897>.

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