A comprehensive assessment of universal health coverage in 111 countries: a retrospective observational study

Adam Wagstaff*, Sven Neelsen*

Summary

Background The goal of universal health coverage (UHC) requires that everyone receive needed health services, and that families who get needed services do not suffer undue financial hardship. Tracking progress towards UHC requires measurement of both these dimensions, and a way of trading them off against one another.

Methods We measured service coverage by a weighted geometric average of four prevention indicators (antenatal care, full immunisation, and screening for breast and cervical cancers) and four treatment indicators (skilled birth attendance, inpatient admission, and treatment for acute respiratory infection and diarrhoea), financial protection by the incidence of catastrophic health expenditures (those exceeding 10% of household consumption or income), and a country's UHC performance as a geometric average of the service coverage index and the complement of the incidence of catastrophic expenditures. Where possible, we adjusted service coverage for inequality, penalising countries with a high level of inequality. The bulk of data used in this study were from the World Bank's Health Equity and Financial Protection Indicators database (2019 version), comprising data from household surveys. Gaps in the data were supplemented with other survey data and (where necessary) non-survey data from other sources (administrative, modelled, and imputed data).

Findings A low incidence of catastrophic expenses sometimes reflects low service coverage (often in low-income countries) but sometimes occurs despite high service coverage (often in high-income countries). At a given level of service coverage, financial protection also varies. UHC index scores are generally higher in higher-income countries, but there are variations within income groups. Adjusting the UHC index for inequality in service coverage makes little difference in some countries, but reduces it by more than 10% in others. Seven of the 12 countries for which we were able to produce trend data have increased their UHC index over time (with the greatest average yearly increases seen in Ghana [1·43%], Indonesia [1·85%], and Vietnam [2·26%]), mostly by improving both financial protection and service coverage. Some increased their UHC index, despite reductions in financial protection, by substantially increasing their service coverage. The UHC index decreased in five of 12 countries with trend data, mostly because financial protection worsened with stagnant or declining service coverage. Our UHC indicators (except inpatient admissions) are significantly and positively associated with GDP per capita, and most are correlated with the share of health spending channelled through social health insurance and government schemes. However, associations of our UHC indicators with the share of GDP spent on health and the shares of health spending channelled through non-profit and private insurance are ambiguous.

Interpretation Progress towards UHC can be tracked using an index that captures both service coverage and financial protection. Although per-capita income is a good predictor of a country's UHC index score, some countries perform better than others in the same income group or even in the income group above their own. Strong UHC performance is correlated with the share of a country's health budget that is channelled through government and social health insurance schemes.

Funding None.

Introduction

The past decade has seen a growing global commitment to universal health coverage (UHC), with many countries embarking on UHC-inspired health reforms and UHC being adopted as one of the new Sustainable Development Goals (SDGs).[1] UHC means that everyone, irrespective of their ability to pay, gets the health services they need without suffering undue financial hardship in the process.[2] Measuring progress towards UHC thus requires simultaneous measurement of progress on both

dimensions of UHC: service coverage and financial protection. However, except for two studies,[3,4] work to date has examined each dimension of UHC in isolation. Such studies are, as has been acknowledged,[5–7] potentially misleading[8] because countries might do well on one UHC dimension but not on the other. Low out-of-pocket expenditure on health could reflect people not getting services they need, or people getting these services but not paying for them out of pocket. Additionally, a high level of use of health services might be associated with a

Research in context

Evidence before this study
We did not do a formal systematic review ahead of this study. Although, several studies have reported estimates for multiple countries of either service coverage or financial protection, only two studies have reported estimates for both these factors and combined them in an inequality-adjusted universal health coverage (UHC) index. The UHC index used in those studies allowed trade-offs between service coverage and financial protection and captured socioeconomic inequality in service coverage. It operationalised financial protection by two indicators: catastrophic out-of-pocket medical spending (defined as that exceeding 10% of household consumption) and impoverishing out-of-pocket medical spending (that pushes households below the poverty line). The eight service coverage indicators in previous studies encompassed preventive as well as curative care, and services related to both infectious and non-communicable diseases. Due to a lack of data, the two previous studies could only estimate the UHC index for 19 low-income and middle-income countries.

Added value of this study
We used the same service coverage indicators as the aforementioned two studies but just one financial protection indicator (catastrophic expenditures at the 10% threshold, the official UHC indicator in the UN Sustainable Development Goals). The study's principal added value comes from the increase in country coverage (51 countries for the inequality-adjusted UHC index, and 111 for an index not adjusted for inequality, including high-income countries), assessing trends in UHC in 12 countries, and analysing the macroeconomic and health system correlates of the components of the UHC index.

Implications of all the available evidence
Although we found positive trends in UHC achievement in recent years for most countries for which data were available, large variation in UHC achievement remains, much of which is explained by differences in gross domestic product. Nevertheless, there is substantial heterogeneity in UHC achievement within income groups, and some countries perform better than countries in the income group above theirs. This finding, as well as the positive associations of the UHC indicators with the shares of a country's health budget that are channelled through government and social health insurance schemes, suggests that there is potential for national health policy makers to accelerate progress towards UHC.

high level of out-of-pocket expenditure but also might not.

This study builds on our earlier work[3,4] that measured progress on both dimensions of UHC simultaneously. This comprehensive approach to tracking progress towards UHC uses an index that allows progress on one UHC dimension to be traded off against progress on the other—a desirable feature given that policy makers seem likely to be willing (up to a point) to accept worse performance on one dimension (eg, financial protection) in exchange for better performance on the other (eg, service coverage). In addition, the approach captures the explicit concern about equity in the concept of UHC: shortfalls from UHC matter more if they are systematically associated with a family's ability to pay. This study extends the geographical coverage from the 19 countries covered in our previous work[3,4] to 111 countries, including high-income countries. We present a snapshot analysis that explores how countries with data on all our UHC indicators compare on the UHC index, a trends analysis that explores how countries with more than 3 years' worth of data on each of a subset of our UHC indicators compare in terms of progress toward UHC, and a regression analysis that explores the relationship between each of our UHC indicators and various macroeconomic and health-system indicators.

Methods
UHC index
Our UHC index is a geometric average of financial protection and service coverage, allowing each to be traded off against each other at a diminishing rate (figure 1, appendix p 2). Our assumption was that policy makers are increasingly reluctant to trade off higher levels of catastrophic health expenses (our measure of the absence of financial protection) for higher levels of service coverage. We divided service coverage into two domains—prevention and treatment—weighted unequally via a geometric average, with each domain computed as a weighted geometric average of four indicators.

Financial protection indicator
The financial protection indicator was (100 minus) the percentage of the population incurring catastrophic out-of-pocket expenses—ie, expenses in excess of 10% (or 25%, in a sensitivity analysis) of their consumption or income (SDG indicator 3.8.2). We used similar methods to those of our earlier global study,[7] except that in this study we related out-of-pocket expenses to household income, rather than household consumption, in high-income countries; we had more high-income countries with income-based estimates and this metric is more common than consumption-based estimates in studies in these countries. In a sensitivity analysis, we explored the implications of using the consumption-based measure in high-income countries.

Service coverage indicator and weighting
Six broad principles underpinned our choice of service coverage indicators. First, the indicators should be indicators of services delivered by health providers. We excluded downstream indicators, notably health
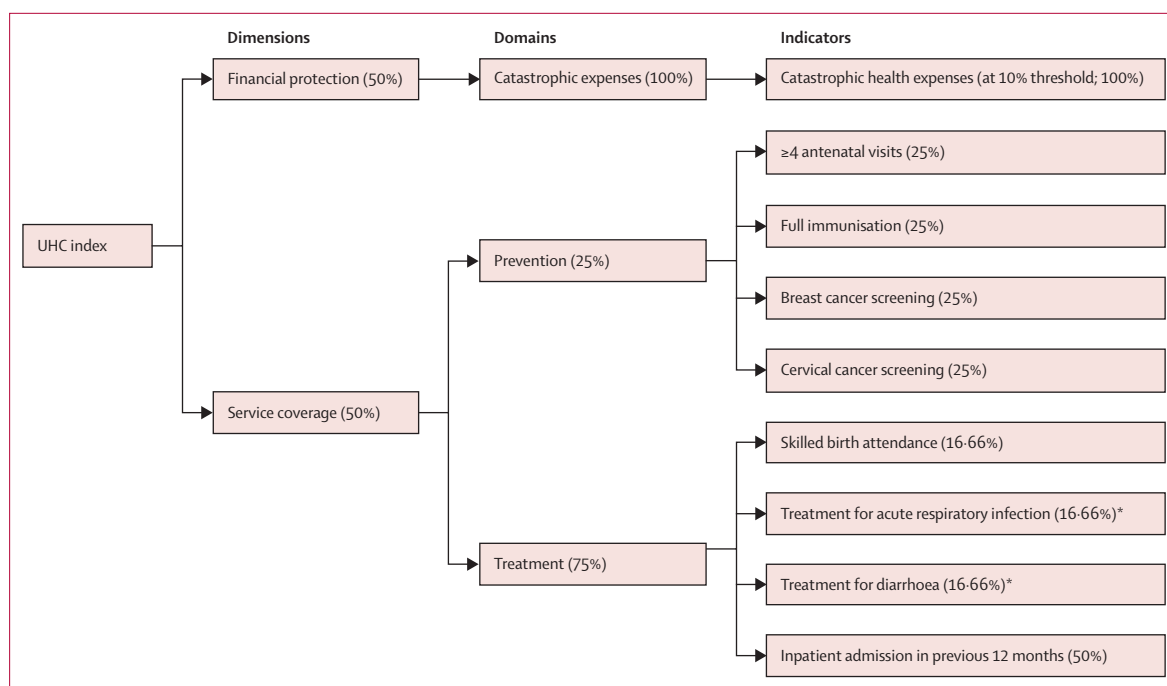
***Figure 1:* Components of the UHC index**
Weights of components are shown in parentheses. UHC=universal health coverage. *For high-income countries, diarrhoea treatment was excluded from the list of treatment indicators and the acute respiratory infection treatment indicator instead received twice the weight (33·33%) as that for middle-income and low-income countries.

behaviours and health outcomes, as these are influenced by health services but also by other factors beyond the health sector. We also excluded upstream indicators, such as health expenditures, health policies, and health infrastructure; these influence service delivery (and thereby also downstream indicators), but service delivery is also influenced by other factors beyond the health sector, such as the level and distribution of household incomes. Second, the indicators should collectively cover a wide range of services relevant to a wide range of users and delivered by a wide range of providers; the services reflected in the indicators should not be overly focused on specific conditions or overly targeted toward a specific demographic group or delivered by a specific set of providers. Third, the services captured by the indicators should reflect priorities, not only those of international experts as reflected in international goals and targets such as the SDGs, but also those of countries themselves in their UHC efforts. Fourth, the data should come, wherever possible, from household surveys (ideally ones that contain sufficient socioeconomic data to allow for disaggregation by socioeconomic status), not from administrative data, whose quality and integrity are often questioned (especially where governments do not face incentives to report accurate numbers),[9–11] and not from modelled data, whose usefulness is also questioned.[12,13] Fifth, each indicator should be able to be related to the population in need of the service, so that it

can be transformed into a coverage indicator. Sixth, the indicators should be widely available.

Our service coverage indicator list was essentially the same as that in our previous two studies,[3,4] which in turn reflects previous work on service coverage measurement in UHC.[2,14] Our indicator definitions and reasons for deviating from indicator lists used in other exercises[5,15] are outlined in the appendix (pp 3–5). Because of the lack of data availability and low incidence of diarrhoea treatment in high-income countries, we omitted diarrhoea treatment from the UHC indicator list in these countries and instead doubled the weight on treatment of acute respiratory infections. The inclusion of the inpatient admission indicator, defined as the proportion of the adult population with an inpatient admission in the past 12 months, reflects countries' efforts as part of their UHC agenda to broaden the scope of services covered to include inpatient care.[16] Unlike the other service coverage indicators, inpatient care cannot be related to need straightforwardly. We normalised this indicator at the population level using the WHO benchmark[17] of 0·1 inpatient admissions per capita, equivalent to 9·03% of the population with an inpatient admission in past 12 months. The normalised rate is expressed as a percentage of this benchmark, or 100% if the rate is above 9·03%. In a sensitivity analysis, we explored the effect of using a lower benchmark in recognition of the fact that high-performing health systems might successfully reduce inpatient admissions

by dealing with ambulatory care-sensitive conditions in a primary care setting.

There is no right or wrong set of service coverage weights, and no right or wrong way to choose them. The various service coverage indicators could be weighted equally, computed using a statistical method such as factor analysis or principal components, or set according to best estimates of their effects on health, ideally measured in a way that captures the quality and length of life. Alternatively, the weight setting could be seen less as a technical exercise and more as a social valuation exercise; the weights could be set by citizens or by policy makers as their representatives.

In this study, the choice of service coverage weights was driven by the health expenditure shares of each service, on the grounds that government and private expenditures reflect the choices that society makes. The 25% weight on prevention is considerably higher than the share of prevention expenditures in total expenditures on preventive and curative care, especially in countries of the Organisation for Economic Co-operation and Development (OECD): the median percentage among the 50 developing countries in the WHO Global Health Expenditure Database (GHED) is 12·4%, while the median among the 31 countries in the OECD Health Statistics database is 4·6%. The 50% weight on inpatient admissions within the treatment domain is in line with the equal spending split between inpatient and outpatient care in developing countries (median 51·2%) and OECD countries (median 48·6%). In a sensitivity analysis, we explored the effect of weighting the service coverage indicators equally.

Adjustment for inequality

To capture socioeconomic inequality in service coverage, we computed (where data allowed) an inequality-adjusted version of the UHC index. In this Article, each service coverage indicator is adjusted downwards according to the degree of inequality, favouring those better off (ie, with greater wealth) in the country in question; in contrast to our earlier two studies, we did not adjust the score upwards for inequalities favouring those who are worse off. Specifically, when there is inequality favouring people who are better off, the score is equal to the population mean of the indicator multiplied by the complement of its concentration index (a measure of inequality across the socioeconomic distribution).[18,19] Where there is no pro-rich inequality, the score is simply equal to the population mean of the indicator.

We did not adjust the incidence of catastrophic expenditures for inequality. Such an approach would be difficult because, in most developing countries, there is little choice but to use consumption rather than income in the denominator, and consumption is inflated by out-of-pocket health expenditures, making households experiencing illness and incurring out-of-pocket expenditures appear better off than otherwise similar households

not experiencing illness, and, perversely, inequalities in catastrophic expenditures are likely to emerge as favouring poorer households.[20]

Data sources

Our starting point in assembling our UHC indicator dataset was the 2019 version of the World Bank's Health Equity and Financial Protection Indicators (HEFPI) database.[21–23] This database draws on more than 1700 household surveys, with the raw microdata reanalysed wherever possible to maximise consistency of indicator definitions across surveys and over time within surveys. For the service coverage indicators, the database contains both the population mean and, wherever possible, the concentration index measure of inequality. The financial protection datapoints in the HEFPI database overlap somewhat with the 2017 World Bank–WHO Global Monitoring Report database used in our global study,[7] but the dataset is larger and covers more countries (appendix pp 9–10).

To maximise geographical coverage and to expand the length of our time series, we supplemented the HEFPI database with survey and (where necessary) non-survey data from other sources (administrative, modelled, and imputed data; appendix pp 11–17). In high-income countries, the biggest gaps were for the maternal and child health indicators; for our supplementary data we relied on sources used by and colleagues[5] (or their datapoints) for child vaccination, antenatal care, and treatment of acute respiratory infections, and on the UNICEF/WHO Joint Database on Skilled Attendance at Birth for skilled birth attendance. In low-income and middle-income countries (LMICs), gaps existed across several service coverage indicators; we filled some of these gaps through a mix of survey-based estimates generated from microdata during the preparation of the HEFPI database but eventually excluded from the database for various reasons (eg, a somewhat different definition from that used in the HEFPI database, a relatively small number of cases for the indicator in question, or a survey being not nationally representative) and estimates derived from reports rather than microdata. After supplementing the HEFPI database, we ended up with a master dataset containing 4579 datapoints across our nine UHC indicators covering 188 countries. Our three analyses—snapshot, trend, and regression analyses—used overlapping subsets of this master dataset.

For the snapshot and trend analyses, we searched for countries within the dataset containing at least one datapoint per UHC indicator, without imposing any restriction on the years to which the datapoints pertain (no country has data on all UHC indicators for a specific year). We found 11 low-income countries that lacked just one or both cancer screening indicators; in these cases, we replaced the missing data by the median values among low-income countries of the indicator in question. We also found five high-income countries that lacked

only skilled birth attendance data; in these cases, we replaced the missing data by the median values of the skilled birth attendance indicator among high-income countries. After adding these 26 imputed datapoints to the HEFPI database and dropping countries with missing data on one or more or of our UHC indicators, we ended up with a dataset of 3495 datapoints covering 75 LMICs and 36 high-income countries.

For the snapshot analysis, we restricted our attention to the most recent one or (if available) two datapoints per indicator. For the trend analysis, we restricted our attention to countries with at least three datapoints per indicator. We excluded the cancer screening indicators from the service coverage indicator list because very few LMICs have trend data for these indicators.

In our regression analysis, we ran regressions indicator by indicator, and did not require countries to have data on all indicators to be included in the regressions; therefore, some countries might appear in some regressions and not others. We did, however, limit our analysis to datapoints for which we have a full set of macroeconomic and health system indicators. For example, a datapoint for catastrophic payment incidence for Angola for 2008 was related to macroeconomic and health system data for Angola for 2008; if Angola's only catastrophic payment datapoint was for 2008, that is the only datapoint for Angola that appears in the catastrophic payment regression. The inpatient admission data were not normalised by the WHO benchmark in the regression analysis, and the 26 imputed datapoints used in the snapshot analysis for cancer screening in low-income countries and for skilled birth attendance in high-income countries were not used in the regression analysis.

GDP and total health expenditure were taken from the World Bank's Open Databases. The shares of current health expenditure channelled through the four aforementioned prepayment schemes were taken from the December 2018 update of the WHO GHED; these data are available only from 2000 to 2016.

Analysis of trends in UHC

Trends in the UHC index would be easy to ascertain if we had data on each UHC indicator for multiple years for each country. In practice, we had only a few countries with multiple years' worth of data on all UHC indicators, but where the data referred to some years for some indicators and other years for other indicators. In this second-best scenario, we exploited the fact that our UHC index is additive in natural logarithms, which allowed us to express the growth rate of the UHC index as a weighted average of the growth rates of each of the UHC indicators, where the weights are the UHC index weights in figure 1 (appendix pp 6–7). Even this scenario turned out to be quite data-demanding, with only two countries being in this situation. We therefore estimated UHC index trends for a restricted version of the index that excluded the cancer screening indicators for which we had very little

trend data. Even with this less restrictive index, we were able to estimate UHC index trends for only 12 countries.

Regression analysis of aggregate correlates of UHC indicators

As in our work on global trends in financial protection,[6,7] we used multiple regression to explore the partial relationship between each UHC indicator and various macroeconomic indicators and health system characteristics. We used essentially the same model and correlates (appendix p 8), with some changes to take advantage of some recent refinements in the WHO GHED. We included one macroeconomic indicator, GDP per capita. We also included health expenditure as a share of GDP. To capture the overall share of health expenditure that is prepaid, and the mix across different prepayment schemes, we included the shares of health expenditure spent by the following: social health insurance schemes; government agencies other than social health insurance schemes (referred to hereafter as government schemes); compulsory private health insurance schemes (eg, compulsory medical savings schemes); non-profit institutions serving households (NPISH); and voluntary health-care payment schemes, excluding NPISH (including voluntary private health insurance and enterprise schemes).[24] The coefficients are to be interpreted as effects relative to the omitted category, payments made out of pocket through no scheme.

All statistical analyses were done with Stata software (version 15.0). t tests were used to test the significance of the marginal effects in the regression analyses. Unless indicated otherwise, the 5% significance level was used.

Role of the funding source

There was no funding source for this study.

Results

The results of our snapshot analysis are shown in figure 2 and figure 3. The snapshot dataset contains 1586 datapoints (1398 [88·1%] survey-based) spanning the period from 1985 to 2018, with a median year of 2011. Unless explicitly indicated, results are for the UHC index where no account has been taken of inequality. Countries doing best are those at the top left corner of figure 3, with low rates of catastrophic expenditure and high rates of service coverage. Data for different indicators can refer to different years, and we have made no attempt to guess the trend to line up the data to the same year. Instead, we used whatever data were available and have indicated in the chart the median years that the financial protection and service coverage data refer to.

Figures 2 and 3 reveal several insights. First, some countries (those at the bottom left in figure 3) have indeed achieved a low incidence of catastrophic expenses and a low level of service coverage (mostly low-income countries) whereas others (those at the top left in figure 3; mostly high-income countries) have achieved a
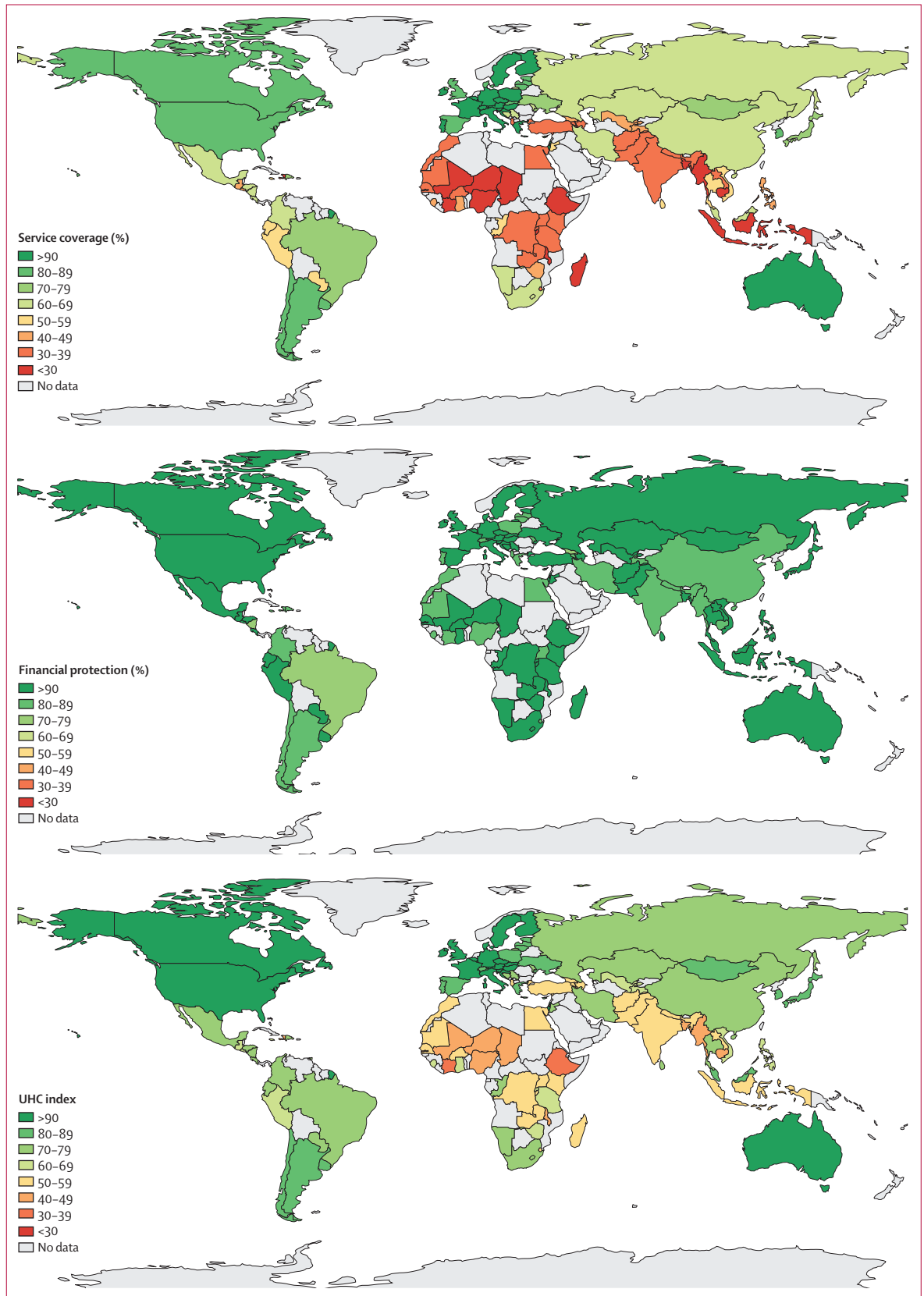
Figure 2: Service coverage, financial protection, and UHC index by country

Numbers are derived from the most recent one or (if available) two datapoints per UHC indicator. Financial protection was defined as 100 minus the incidence of catastrophic health expenditure (at the 10% threshold). UHC=universal health coverage.

low incidence of catastrophic expenses despite achieving a high rate of service coverage. Likewise, the incidence of catastrophic expenses varies across countries with similar levels of service coverage. For example, China, Mexico, and South Africa all have a service coverage score of around 60; however, South Africa has a lower incidence of catastrophic spending than Mexico, which has a (much) lower incidence of catastrophic spending than China. In short, both service coverage and financial protection need to be considered to get a sense of how close a country is to achieving UHC.

Second, a country's UHC index score tends to be higher the higher the country's income group: the high-income countries tend to cluster at the top left of figure 3, while the low-income countries tend to cluster at the bottom left. However, there are variations within income groups. Some low-income countries (eg, Comoros and Zimbabwe) achieve higher UHC scores than several lower-middle-income countries. Some lower-middle-income countries (eg, Bangladesh and Nigeria) achieve lower UHC scores than several low-income countries, while other lower-middle-income countries (eg, Mongolia and Ukraine) achieve higher UHC scores than several upper-middle-income countries. Among the middle-income countries, there are weaker and stronger per-formers, with countries like Azerbaijan achieving a lower UHC score than even some low-income countries, and middle-income countries like Costa Rica and Mexico achieving UHC scores on a par with some high-income countries. Among high-income countries, Chile, Japan, and Trinidad and Tobago stand out as weaker performers on the UHC index; in the case of Chile, the high rate of catastrophic health expenditure is largely to blame, whereas the poorer performance in Japan and Trinidad and Tobago reflects low inpatient admission rates and low cancer screening rates.

Third, countries vary in their mix of service coverage and financial protection for a given level of UHC. For example, Brazil and Serbia, both upper-middle-income countries, have the same UHC index value (75). Brazil's service coverage score far exceeds Serbia's (61%), but this is counterbalanced in the UHC index by Brazil's substantially higher incidence of catastrophic expenditure (26% vs 8%).

We examined the sensitivity of our results to four of our assumptions (appendix pp 18–22). The biggest effects in terms of the rank order of countries involved switching to equal weights in the service coverage index (rank correlation 0·9770, p<0·0001; correlation 0·9759, p<0·0001) and switching from the 10% to the 25% threshold in computing catastrophic expenses (rank correlation 0·9892, p<0·0001; correlation 0·9932, p<0·0001). By contrast, only tiny rank order changes occurred as a result of reducing the inpatient admission rate benchmark (rank correlation 0·9952, p<0·0001; correlation 0·9958, p<0·0001) and using consumption in all countries when computing catastrophic expenditure (rank correlation 0·9990, p<0·0001; correlation 0·9993, p<0·0001). These
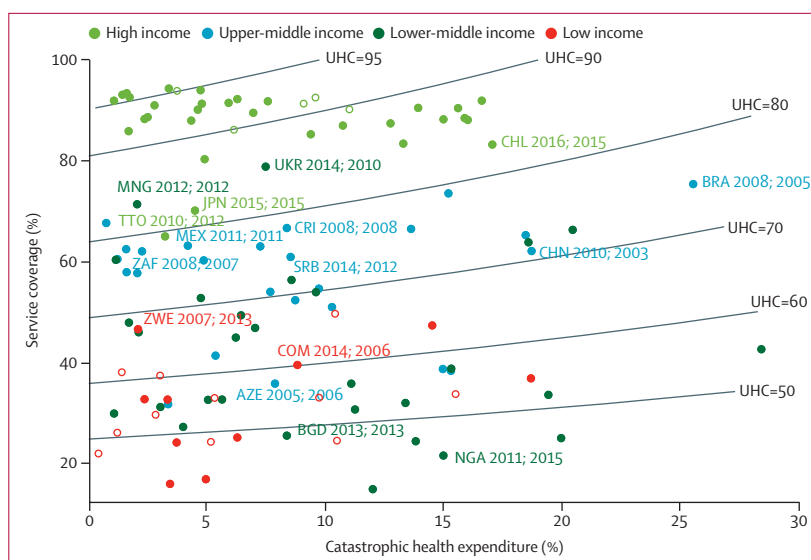
Figure 3: UHC index
Data are based on the most recent one or two surveys from each country. The first date after each country code indicates the median year that the financial protection data refer to, and the second date indicates the median year that the service coverage data refer to. Incidence of catastrophic health is expenditure is shown at the 10% threshold. Contours show the combinations of service coverage and catastrophic expenses that produce the same value of UHC index. Unfilled datapoints are low-income and high-income countries for which missing data were replaced by median values for that income group for one or more indicators (cancer screening in low-income countries and skilled birth attendance in high-income countries). AZE=Azerbaijan. BGD=Bangladesh. BRA=Brazil. CHL=Chile. CHN=China. COM=Comoros. CRI=Costa Rica. JPN=Japan. MEX=Mexico. MNG=Mongolia. NGA=Nigeria. SRB=Serbia. THA=Thailand. TTO=Trinidad and Tobago. UHC=universal health coverage. UKR=Ukraine. ZAF=South Africa. ZWE=Zimbabwe.

changes can affect a country's UHC index, and in some cases the effect can be pronounced: reducing the inpatient benchmark increases the UHC index of countries such as Thailand and Japan, which have relatively low inpatient admission rates.

Figure 4 shows the UHC index before and after adjusting for inequality in service coverage for countries where data on service coverage inequalities are available. The adjustment makes little difference in some countries, but a sizeable difference in others: in Bangladesh, Chad, Côte d'Ivoire, Ethiopia, Guatemala, Indonesia, and Laos, accounting for inequality reduces the UHC index by more than 10%. In the cases of Laos and Guatemala, the reduction in the UHC index is as much as 8 percentage points. In some cases, the adjustment results in countries changing their international ranking: for example, both Indonesia and Laos slip behind Malawi once inequality in service coverage is captured.

Table 1 examines trends in the UHC index and its components for the 12 countries for which we had 3 or more years' worth of data on the service coverage indicators (other than cancer screening) and financial protection (measured by 100 minus catastrophic expenditure inci-dence). This dataset contains 470 datapoints (470 [100%] survey-based) across 12 countries (all LMICs), spanning the period from 1996 to 2017, with a median year of 2008. Overall, although the median country increased its service coverage index, five countries saw their service coverage

index fall; five countries also saw their performance on financial protection deteriorate. More countries saw increases in their UHC index than decreases, and three saw marked increases: Ghana (average yearly increase 1·43%), Indonesia (1·85%), and Vietnam (2·26%). Ghana and Vietnam also stand out as having seen improvements across all seven UHC indicators. Moreover, the low growth rate of inpatient admissions in these two countries relative to Indonesia reflects the fact that both are at or close to the WHO recommended rate (100% [Ghana] and 96% [Vietnam]), whereas Indonesia is still far below it (45%). Of the seven countries who saw their UHC index increase, five did so despite deteriorations in financial protection. By contrast, no country increased its UHC index by improving financial protection at the expense of worse

service coverage. Three countries (Malawi, the Philippines, and Tanzania) saw deteriorations in both service coverage and financial protection over the periods covered by our data.

Correlates of the UHC index components from our regression analysis are shown in table 2. This dataset consists of 3407 datapoints, covering 173 countries over the period from 2000 to 2015. GDP per capita was positively and significantly associated with all service coverage indicators except inpatient admissions, but not with catastrophic expenditures; overall, therefore, GDP per capita had a positive (or at least not negative) association with our UHC indicators. The share of GDP spent on health was positively associated with all eight service coverage indicators but also positively associated with the incidence of catastrophic spending; thus, overall, the share of GDP spent on health has an ambiguous association with our UHC indicators. The shares of total health expenditure channelled through social health insurance schemes and government financing arrangements were all positively and (except in one case) significantly associated with all five maternal and child health service coverage indicators; and positively associated with the inpatient admission rate, but the effect was significant only at the 10% level. For all five maternal and child health indicators, the effect of spending channelled through social health insurance schemes was larger, and significantly so for antenatal care, skilled birth attendance, and the treatment of acute respiratory infection. Expenditure by both schemes was negatively associated with the incidence of catastrophic expenses; only in the case of the government scheme was the effect significant, but the difference between the two was not significant. Overall, expenditures by both social health insurance and government financing schemes were positively associated with our UHC indicators. Spending by compulsory private health insurance schemes was positively and significantly associated with four service coverage indicators but negatively associated with inpatient admissions (albeit significantly so only at the 10% level) and not associated with the incidence of catastrophic expenses; the overall effect of compulsory private health insurance schemes on our UHC indicators is therefore ambiguous. Spending by non-profit schemes was negatively and significantly associated with the incidence of catastrophic expenses but positively associated only with the treatment of acute respiratory infection and diarrhoea, and negatively associated with inpatient admissions; overall, therefore, the association between spending by non-profit schemes and our UHC indicators is ambiguous. Voluntary scheme expenditures have an almost non-existent relationship with our UHC indicators.
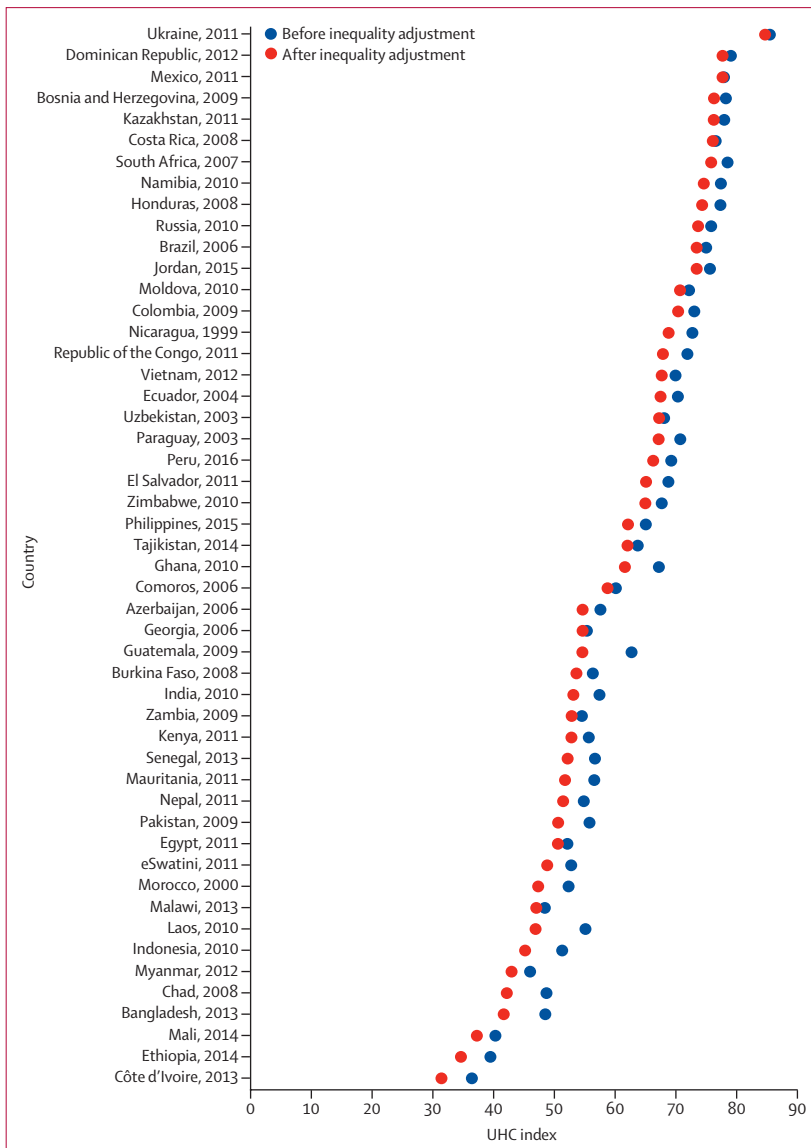
Discussion

This analysis measured progress toward UHC for 111 countries using an index based on eight service

Figure 4: **Effect of adjusting UHC index for inequalities in service coverage**
UHC=universal health coverage.

	First year	Last year	Annual average percentage change								
			Antenatal care	Vaccination	Skilled birth attendance	Treatment of acute respiratory infections	Treatment of diarrhoea	Inpatient admissions	Service coverage	Financial protection*	UHC index
Armenia	1999	2015	3·18%	1·10%	0·17%	8·10%	1·71%	−5·71%	−0·36%	0·21%	−0·08%
Ghana	1998	2014	2·25%	1·67%	3·71%	3·92%	3·16%	1·75%	2·50%	0·36%	1·43%
Indonesia	1997	2015	1·22%	1·19%	3·12%	0·79%	−1·37%	8·66%	3·87%	−0·16%	1·85%
Kenya	1997	2015	−0·64%	1·76%	3·02%	0·28%	2·72%	−2·21%	0·06%	0·03%	0·05%
Malawi	2000	2016	−1·32%	0·72%	4·30%	6·77%	1·99%	−4·46%	−0·11%	−0·16%	−0·14%
Mexico	1996	2015	0·92%	0·66%	0·57%	0·48%	3·06%	−1·44%	0·17%	0·72%	0·45%
Nigeria	2000	2016	0·31%	6·71%	0·92%	−2·77%	5·53%	−0·55%	1·13%	−0·07%	0·53%
Peru	1996	2016	2·70%	0·55%	2·69%	−0·01%	1·26%	−0·99%	0·53%	0·26%	0·40%
Philippines	1998	2017	1·87%	0·01%	1·88%	0·46%	0·47%	−2·50%	−0·35%	−0·28%	−0·31%
Tanzania	1996	2015	−2·69%	0·52%	2·01%	−2·06%	−0·82%	0·59%	−0·16%	−0·17%	−0·16%
Thailand	2002	2015	−0·29%	−0·56%	0·23%	−0·48%	2·11%	−2·58%	−0·84%	0·27%	−0·28%
Vietnam	1997	2016	10·08%	2·39%	1·66%	0·97%	13·14%	1·82%	4·21%	0·30%	2·26%

UHC=universal health coverage. *Defined as 100 minus the percentage of people incurring catastrophic out-of-pocket expenses at the 10% level.

Table 1: **Trends in UHC index and its components**

	Cervical cancer screening	Breast cancer screening	Antenatal care	Full immunisation	Skilled birth attendance	Treatment of acute respiratory infections	Treatment of diarrhoea	Inpatient admissions	Catastrophic health expenditure
Per capita GDP, 2011 international $	0·950 (p<0·0001)	1·296 (p<0·0001)	1·471 (p<0·0001)	0·635 (p=0·0012)	0·657 (p<0·0001)	1·650 (p<0·0001)	2·738 (p<0·0001)	0·071 (p=0·12)	0·080 (p=0·39)
Total health expenditure (as % of GDP)	1·579 (p=0·021)	2·675 (p=0·0002)	1·487 (p=0·010)	1·835 (p<0·0001)	1·097 (p=0·012)	1·532 (p=0·0004)	1·460 (p=0·0021)	0·344 (p=0·0019)	0·770 (p=0·0028)
Social health insurance schemes as % of current health expenditure	0·161 (p=0·23)	0·219 (p=0·12)	0·387 (p<0·0001)	0·317 (p=0·0003)	0·292 (p<0·0001)	0·290 (p=0·0003)	0·063 (p=0·78)	0·037 (p=0·090)	−0·044 (p=0·13)
Government schemes as % of current health expenditure	0·064 (p=0·64)	0·292 (p=0·066)	0·156 (p=0·074)	0·297 (p<0·0001)	0·187 (p=0·0059)	0·137 (p=0·033)	0·163 (p=0·023)	0·025 (p=0·079)	−0·082 (p=0·0031)
Compulsory private insurance as % of current health expenditure	1·128 (p=0·021)	0·584 (p=0·12)	1·479 (p=0·042)	1·350 (p=0·031)	0·354 (p=0·39)	1·815 (p=0·023)	−0·138 (p=0·95)	−0·109 (p=0·059)	−0·097 (p=0·51)
Non-profit schemes as % of current health expenditure	0·046 (p=0·94)	0·966 (p=0·23)	−0·081 (p=0·66)	0·009 (p=0·94)	0·603 (p=0·21)	0·269 (p=0·013)	0·502 (p<0·0001)	−0·100 (p=0·0053)	−0·157 (p=0·0053)
Voluntary health-care payment schemes as % of current health expenditure	0·214 (p=0·34)	0·165 (p=0·40)	0·656 (p=0·0009)	0·142 (p=0·58)	0·305 (p=0·060)	−0·081 (p=0·62)	0·211 (p=0·48)	−0·034 (p=0·30)	−0·003 (p=0·97)
Number of observations	261	226	318	342	797	332	271	317	501
p value*	0·32	0·26	0·0030	0·77	0·020	0·037	0·67	0·56	0·21

Data are regression coefficient (p value) unless otherwise stated. GDP=gross domestic product. *For social health insurance schemes as % of total health expenditure equalling government schemes as % of total health expenditure.

Table 2: **Multiple regressions showing marginal effects of macroeconomic and health systems characteristics on universal health coverage indicators at median per-capita GDP**

coverage indicators and one financial protection indicator that penalises unequal service coverage rates disfavouring the poor. Our indicators were taken largely from household survey data. Our results show large variations in progress toward UHC across the world. We found a substantial degree of heterogeneity in financial protection at given levels of service coverage and vice versa, a finding that underscores that, to be meaningful, measures of UHC must consider both these dimensions simultaneously. Where data were available to observe country trends, we found that most countries have increased their UHC index and that this increase has generally involved improved service coverage. The increases in the index, however, did not necessarily coincide with improvements in financial protection, highlighting a potential trade-off between the two UHC dimensions and the need to make advances on financial protection as well as service coverage to move towards UHC; that said, worsening financial protection need not necessarily be due to increased out-of-pocket expenses on services captured by the UHC index. Finally, we found our UHC indicators to be positively related to national income levels and to the share of health spending that is channelled through social health insurance and government schemes, but an ambiguous relationship with the share of GDP spent on health.

Although tractable and informative, and potentially useful in global and country-level UHC monitoring exercises aiming to get a comprehensive picture of progress toward UHC, our operationalisation of our UHC index approach suffers from some data-related limitations. Our adjustment of the inpatient admission rate using the WHO benchmark—despite being the best that could be done with existing data—is crude and risks penalising countries that have made progress in reducing their inpatient admission rate below the WHO benchmark by treating ambulatory care-sensitive conditions in a primary care setting. This limitation is especially important to highlight given the high weight on inpatient admissions in our UHC index. Reassuringly, however, the country ranking was fairly insensitive to whether the service coverage indicators were weighted unequally per our scheme or equally, and moreover that the standard correlation between the two versions of the index was as high as 0·9759. Nevertheless, some countries and groups of countries (notably those with low or lower-middle income) were especially sensitive to the weight placed on inpatient admissions (appendix p 19).

A second limitation of our study is that our list of service coverage indicators was shorter than desirable. Some indicators were excluded on the grounds that do not reflect closely enough the provision of a service. For example, we excluded unmet need for family planning because studies[25,26] suggest that the major barriers are not related to health services (eg, affordability and availability) but rather to households and communities (eg, a husband's opposition to contraception or his fear of infidelity). We accept nonetheless that it could be interesting to see how sensitive our UHC index levels and rankings are to the inclusion of family planning. The other important reason for our exclusion of other service coverage indicators was data availability. Given our inclusion criteria, we required household surveys that captured the need for health interventions and their receipt, and the socioeconomic characteristics of the individual's household. Some surveys (eg, the DHS) contain rich socioeconomic data but are limited in their health data beyond the traditional maternal and child health indicators, whereas other surveys (eg, the STEPwise approach to Surveillance and tuberculosis prevalence surveys) contain rich data on need for and receipt of care with regard to conditions not captured in our index, but rarely contain socioeconomic data.[27]

A third limitation of this study is that our list of service coverage indicators captured coverage rather than effective coverage. Making quality adjustments to convert coverage into effective coverage has, to our knowledge, been done only in the case of antenatal care.[28,29]

The limitations noted above are shortcomings in the operationalisation of the UHC index, rather than in the concept of the index itself. In future research, a challenge will be to extend the service coverage indicator list and move from coverage indicators to effective coverage indicators without losing the inequality angle of our UHC index. This is likely to involve a combination of improved access to existing household surveys and an increase in the scope of new surveys, especially multipurpose surveys that capture both household out-of-pocket health expenses and the need for and use of specific health services. Better routine data from health information systems might also play a role, but such data pose challenges, being susceptible to deliberate misreporting when incentives encourage it and almost always lacking the necessary socioeconomic data to adjust for inequality.

This study has shown that progress towards UHC can be tracked using an index that captures both service coverage and financial protection. We found a large variation in UHC achievement across countries. Much of this variation is explained by differences in GDP. However, some countries perform better than others in the same income group, and some perform better than countries in the income group above theirs. Strong UHC performance is correlated with the share of a country's health budget that is channelled through government and social health insurance schemes.

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