Trends and projections of universal health coverage indicators in Ghana, 1995-2030: A national and subnational study

Cherri Zhang[1,2]*, **Md. Shafiur Rahman**[1,3], **Md. Mizanur Rahman**[1,3], **Alfred E. Yawson**[4], **Kenji Shibuya**[1,5]

1 Department of Global Health Policy, The University of Tokyo, Tokyo, Japan, **2** Department of Critical Care Medicine, University of Calgary, Calgary, Alberta, Canada, **3** Global Public Health Research Foundation, Dhaka, Bangladesh, **4** Department of Community Health, School of Public Health, University of Ghana, Accra, Ghana, **5** University Institute for Population Health, King's College London, London, United Kingdom

* toki.cherri.zhan28@gmail.com

Abstract

Ghana has made significant stride towards universal health coverage (UHC) by implementing the National Health Insurance Scheme (NHIS) in 2003. This paper investigates the progress of UHC indicators in Ghana from 1995 to 2015 and makes future predictions up to 2030 to assess the probability of achieving UHC targets. National representative surveys of Ghana were used to assess health service coverage and financial risk protection. The analyses estimated the coverage of 13 prevention and four treatment service indicators at the national level and across wealth quintiles. In addition, we calculated catastrophic health payments and impoverishment to assess financial hardship and used a Bayesian regression model to estimate trends and future projections as well as the probabilities of achieving UHC targets by 2030. Wealth-based inequalities and regional disparities were also assessed. At the national level, 14 out of the 17 health service indicators are projected to reach the target of 80% coverage by 2030. Across wealth quintiles, inequalities were observed amongst most indicators with richer groups obtaining more coverage than their poorer counterparts. Subnational analysis revealed while all regions will achieve the 80% coverage target with high probabilities for the prevention services, the same cannot be applied to the treatment services. In 2015, the proportion of households that suffered catastrophic health payments and impoverishment at a threshold of 25% non-food expenditure were 1.9% (95%CrI: 0.9–3.5) and 0.4% (95%CrI: 0.2–0.8), respectively. These are projected to reduce to 0.4% (95% CrI: 0.1–1.3) and 0.2% (0.0–0.5) respectively by 2030. Inequality measures and subnational assessment revealed that catastrophic expenditure experienced by wealth quintiles and regions are not equal. Significant improvements were seen in both health service coverage and financial risk protection over the years. However, inequalities across wealth quintiles and regions continue to be cause of concerns. Further efforts are needed to narrow these gaps.

Introduction

Universal Health Coverage (UHC) is a concept in which all people receive the quality, essential services they need without experiencing financial hardship [1, 2]. The First Global Monitoring Report formulated by the World Health Organizations (WHO) and World Bank identified three dimensions: population, health services, and financing through risk pooling mechanism to track UHC progress [1]. Since its integration into the recently adopted Sustainable Development Goal (SDG) 3, member countries of the United Nations (UN) have committed to achieve UHC by 2030 [3]. This commitment consists of two targets: a minimum of 80% essential health service coverage for all people, regardless of socioeconomic status, and 100% financial risk protection from out-of-pocket (OOP) payments for health care [1]. UHC is a key mechanism to ensure affordability and equity as well as to guarantee resilient health system, which many countries have embraced in order to achieve better health for all [1].

Achieving UHC in Sub-Saharan Africa should be of utmost priority as countries in this region trail significantly behind in achieving health outcomes especially the Millennium Development Goals (MDGs) formulated by the WHO. Moreover, millions of Africans fall into poverty annually due to OOP payment as a result of lack of health insurance in health financing system [4, 5]. Ghana, being one of the few Sub-Saharan African countries advocating for UHC, implemented the National Health Insurance Scheme (NHIS) in 2003, in an attempt to remove financial barriers, protect Ghanaians from catastrophic expenditure, and improve access for everyone [6]. NHIS is mainly funded by three sources: 70% of National Health Insurance Levy (NHIL), 17.4% of Social Security and National Insurance Trust (SSNIT), and 4.5% of premium payments [7]. NHIL is a 2.5% tax on selected goods and services; SSNIT is a 2.5% contribution paid by those in the formal sectors, and premium is set at an annual flat rate of $4.8 USD to $32 USD depending on districts for those in the informal sectors. Pregnant women and those under the age of 18 years or over 70 years of age are exempt from premium and make up 60% of the enrollees [8].

Services covered under the insurance include outpatient and inpatient care, oral health, eye care, maternity care, and emergencies with no copayment upon receipt of services. It excludes cosmetic services, HIV antiretroviral drugs, orthopedics, and organ transplant etc. [9]. Despite enrollment into NHIS being mandatory, overall enrollment remains low at 40% as of 2016 since majority of the population belongs to the informal sector, and there is a lack of formal tracking regulations [7]. Although Ghana made significant stride towards health financing in recent years; however, Gross Domestic Product (GDP) spending on health and total government expenditure allocated to health has dropped since 2010 to 3.6% and 6.8%, respectively in 2014 [10]. Furthermore, other challenges such as funding and sustainability persist as overall enrollment has decreased in recent years and many citizens find paying for premiums difficult. In addition, as the incidence of poverty is around 25% with some regions such as Upper East and Upper West experiencing more than 70% incidence of poverty, inequality remains a prominent issue especially across regions [9]. Inadequate funding for health can lead to unstable health insurance scheme and an increase in OOP payments, pushing people further into poverty and worsen health outcomes.

Most studies conducted in Ghana thus far assessed either health service access or financial catastrophe; therefore, this paper offers a glimpse into Ghana's progress towards both UHC components, along with future trajectories. It will provide a thorough examination on the proportion of health service utilization as well as catastrophic health expenditures at the national and subnational level as well as across wealth quintiles using nationally representative survey data.

Methods

Data source

Analysis on health service coverage was carried out using five consecutive Demographic and Health Surveys (1993, 1998, 2003, 2008, and 2014). These are nationally representative household surveys covering all 10 regions of Ghana. Information mainly on housing and household characteristics, education, maternal and child health, fertility, family planning, and nutrition were collected. Analysis of financial risk protection was conducted using Ghana Living Standard Surveys (1991–1992, 1998–1999, 2005–2006, and 2012–2013), which are nationwide household surveys constructed to gather information on living conditions in Ghana. The surveys collected detailed information on household demographics, education, health, employment, migration, housing conditions, agriculture, and access to financial services and asset ownership. Both national surveys involved two-stage random sampling design with high response rates (S11 Table).

Measurement of health service indicators

In accordance with the WHO and World Bank's framework [1], 17 health service indicators (S1 Table) were chosen to cover a full range of prevention and treatment services based on data availability.13 indicators were classified as prevention services while four indicators were classified as treatment services. The chosen indicators were grouped into: 1) composite prevention index and 2) composite treatment index. These were estimated as the mean value of prevention and treatment service indicators to trace the overall progress of prevention and treatment coverage [11]. Due to incomplete data for some of the indicators in certain survey years, only nine out of the 13 prevention indicators (four antenatal care visits, exclusive breastfeeding, needs for family planning satisfaction, improved water, adequate sanitation, BCG, measles, DPT3 and Polio3 immunizations) were included to estimate the composite prevention index. Furthermore, a Composite Coverage Index (CCI) was estimated to assess access to maternal and child health services as it frequently represents frontline measurement of health service coverage and produce the most immediate picture of accessibility [11, 12]. It was calculated based on eight interventions from four specialties (treatment of childhood illnesses, family planning, maternal and newborn care, and immunization) using a formula developed by Boerma and colleagues [12].

Measurement of financial hardship

Incidence of catastrophic health expenditure (CHE) and impoverishment due to OOP health payments were approximated for financial hardship assessment. Several thresholds can be considered according to World Bank's guideline [13]. In this analysis, a threshold of 25% non-food consumption expenditure was used; therefore, a household's health expenditure was deemed catastrophic if its total OOP health payments exceeded that threshold. Consistent with the WHO's guideline [14], the incidence of impoverishment was derived using poverty line and subsistence spending. A household was considered poor if its total per capita expenditure was less than its subsistence spending after paying for healthcare, and thus a household's health expenditure was considered impoverishing if its total per capita spending after paying for health care was below the poverty line [14]. Poverty line was determined using average food expenditure of households with food expenditure share within 45th and 55th percentile of the sampled households [14]. A household was deemed to be experiencing hardship if it encountered either CHE or impoverishment. All household consumption calculations were performed following the Living Standard Measurement Study guideline [13].

Statistical analysis

All trends and projections for health service coverage and financial risk protection components were estimated based on proportions estimated from original survey data with 95% confidence interval (CI). The composite prevention and treatment indices were developed based on random-effects meta-analysis [15]. For equity analysis, households were divided into five wealth quintiles (Q1-Q5) to assess socio-economic status. Due to the lack of information on income as most Ghanaians belong to the informal sector, household economic status was measured based on the level of consumption or asset-based wealth index. The index was constructed from household asset data using principle components analysis and a wealth score was generated for each household. This information was provided in the Demographic and Health Surveys as well as Ghana Living Standard Measurement Surveys. Households were ranked based on wealth scores and divided into quintiles, starting from the poorest quintile (lowest 20%) to the richest quintile (highest 20%). The slope index of inequality (SII) and the relative index of inequality (RII) were calculated to provide an absolute and relative measure of inequality, respectively. SII measures the absolute difference between the extremes of wealth quintiles and reflects the difference in percentage points in each indicator, while RII is a measure of ratio signifying the degree of inequality [11]. SII and RII were calculated by regressing outcomes of health service and financial indicators against household's relative rank in the cumulative distribution of wealth position. All aforementioned analyses were performed using Stata (version 15.0/MP, StataCorp).

A Bayesian linear regression model with a non-informative prior was developed, considering year as the covariate, to estimate the trends in indicators over time and its posterior predictive distribution. All proportions were logit transformed before the analysis, and all calculations were conducted as such. Markov Chain Monte Carlo (MCMC) algorithm was applied to obtain 1000 samples from the posterior distribution of the parameter of interest using two chains. For each of the chain, the first 5000 iterations were discarded as burn-ins and the number of iterations increased until the MCMC outputs converged. These posterior predictive distributions were used to obtain projections and credible intervals up to year 2030. They were also utilized to calculate the annual rate of change and the probability of achieving UHC targets for all included indicators. Another wealth quintile adjusted model with non-informative prior was fitted to estimate the predicted coverage of all indicators for different socio-economic groups. Convergence of MCMC outputs was assessed by visually examining trace plots. Posterior samples were considered to have converged when outputs from two chains adjoined. Additionally, Gelman-Rubin diagnostic statistics were applied as a quantifiable measure of convergence. A potential scale reduction factor (PSRF) was used in the Gelman diagnostic, where a PSRF value close to 1 signified convergence, and a PSRF value greater than 1.02 indicated convergence failure. To further assess the accuracy of the model, a deviance information criterion (DIC) was calculated for each indicator at the wealth quintile and subnational level in the case that quintiles or regions also acted as covariates. For every single estimate of trend and projection in health service coverage, a DIC value was calculated for model with and without interaction. The model with a smaller penalized deviance was integrated into the analysis (S2 Table). Bayesian regression models were developed in JAGS and implemented in R.

Results

Health service coverage

Table 1 lists the predicted coverage of 17 chosen health service indicators, grouped into prevention and treatment categories along with 95% credible intervals (CrI), the probability of achieving the target of 80% coverage by the year 2030, as well as the annual rate of change

Table 1. National health service coverage with probability of achieving the target and rate of change, 1995–2030.

| Indicators	Predicted coverage in year (95% CrI)				Probability[a]	Annual % change[b]
	1995	2005	2015	2030		
Prevention indicators						
Needs for family planning satisfied	36.6 (30.5–42.7)	41.4 (37.2–45.7)	46.3 (38.5–54.3)	53.7 (38.4–68.9)	0.9%	1.1 (-0.2–2.3)
At least four antenatal care visits	57.9 (49.6–63.5)	73.7 (69.3–77.8)	84.9 (78.3–89.4)	93.9 (87.5–97.5)	99.9%	1.4 (0.9–2.0)
Postnatal care for mothers	–	10.6 (5.6–17.6)	79.9 (61.7–91.3)	99.8 (99.0–100.0)	100%	18.6 (13.5–23.9)
Exclusive breastfeeding	16.6 (9.6–25.2)	40.7 (31.2–50.5)	70.1 (52.3–83.2)	92.6 (77.1–98.5)	96.3%	5.3 (3.4–7.1)
Insecticide treated bed nets for children	–	10.5 (5.9–17.0)	62.7 (42.7–80.4)	98.1 (91.1–99.9)	99.5%	10.4 (7.5–13.2)
Insecticide treated bed nets for mothers	–	6.7 (3.8–10.7)	56.7 (37.2–74.4)	98.3 (91.8–99.9)	99.6%	12.2 (9.2–15.1)
BCG immunization	84.9 (80.4–88.6)	93.4 (92.1–94.7)	97.2 (95.9–98.2)	99.2 (98.4–99.7)	100%	0.5 (0.3–0.7)
DPT3 immunization	67.4 (59.9–75.0)	82.1 (78.0–85.6)	90.9 (86.3–94.3)	96.8 (93.2–98.8)	100%	1.1 (0.6–1.5)
Polio3 immunization	67.9 (58.9–76.2)	79.6 (75.1–83.9)	87.6 (81.8–92.4)	94.2 (87.3–98.0)	100%	1.0 (0.5–1.5)
Measles immunization	69.5 (60.6–77.9)	83.8 (79.9–87.5)	92.0 (87.5–95.1)	97.3 (93.4–99.1)	100%	1.0 (0.6–1.5)
Improved water	60.9 (50.9–70.4)	77.0 (71.7–82.0)	87.6 (80.9–92.6)	95.3 (88.7–98.5)	100%	1.4 (0.7–2.0)
Adequate Sanitation	24.6 (18.7–32.8)	43.2 (37.8–49.4)	64.1 (53.3–73.7)	86.0 (72.4–94.1)	88.4%	3.8 (2.6–4.8)
No-use of tobacco	–	91.5 (87.6–94.4)	91.1 (85.3–95.2)	88.8 (62.9–98.3)	87.5%	-0.1 (-1.0–0.6)
Treatment indicators						
Institutional delivery	40.3 (31.2–50.8)	56.7 (49.6–63.2)	71.5 (59.3–81.6)	86.3 (69.9–95.1)	86.2%	2.3 (1.1–3.3)
Skilled birth attendance	41.3 (31.6–52.0)	57.5 (50.4–63.8)	72.1 (61.0–81.4)	86.6 (70.7–95.2)	88.1%	2.2 (1.2–3.2)
Oral rehydration therapy	39.5 (27.8–51.6)	55.6 (46.9–64.0)	70.5 (55.8–82.1)	85.2 (63.4–95.9)	79.5%	2.3 (0.8–3.5)
Care seeking for pneumonia	35.9 (25.9–46.6)	42.7 (34.6–50.2)	49.9 (33.8–64.0)	59.9 (30.1–83.6)	5.1%	1.5 (-0.6–3.3)

Note:

[a]The probability of meeting the target of 80% health service coverage by 2030 for the entire population, regardless of economic status, gender, or place of residence according to WHO's universal health coverage target.

[b] The annual rate of change for the period 1995-2030.Trends and projections for all the year from 1993–2030 at the national level and across wealth quintiles for all indicators are shown in appendix (p13-21). CrI = credible interval; DPT3 = three doses of DPT immunization; Polio3 = three doses of polio immunization.

https://doi.org/10.1371/journal.pone.0209126.t001

from 1995 to 2030. Based on future projections, most prevention service indicators are estimated to have more than 90% probability of achieving the target except need for family planning satisfied, adequate sanitation, and non-use of tobacco. Amongst the treatment indicators, care seeking for pneumonia among children has the lowest probability of reaching the target at 5.1% while access to institutional delivery and use of skilled birth attendance will have more than 85% probability.

A notable achievement is the national coverage of the four childhood vaccinations (BCG, measles, three doses of DPT and polio vaccination) which had already reached the target in 2015. In addition, coverage for maternal postnatal care increased from 10.6% (95%CrI: 5.6–17.6) in 2005 to 79.9% (95% CrI: 61.7–91.3) in 2015. The lowest coverage among the poorest quintile was observed in adequate sanitation at 6.5% (95% CrI:3.4–11.1) in 2015. This is followed by need for family planning demand satisfied at 38.1% (95%CrI: 31.1–45.1) and access to skilled birth attendance at 38.9% (95% CrI: 25.3–53.7). It is expected that all quintiles will fail to achieve the 80% coverage target for family planning demand satisfied and care seeking for pneumonia. Besides the two aforementioned indicators, the richest quintile is highly likely to reach the target for most indicators except polio vaccination and insecticide treated bed nets use by children under five. A detailed breakdown of coverage by wealth quintile for each indicator can be found in S3–S6 Tables and S2–S10 Figs.

In order to provide a broader picture regarding the coverage of prevention and treatment services, the composite prevention and treatment indices (Figs 1 and 2) illustrate that overall national
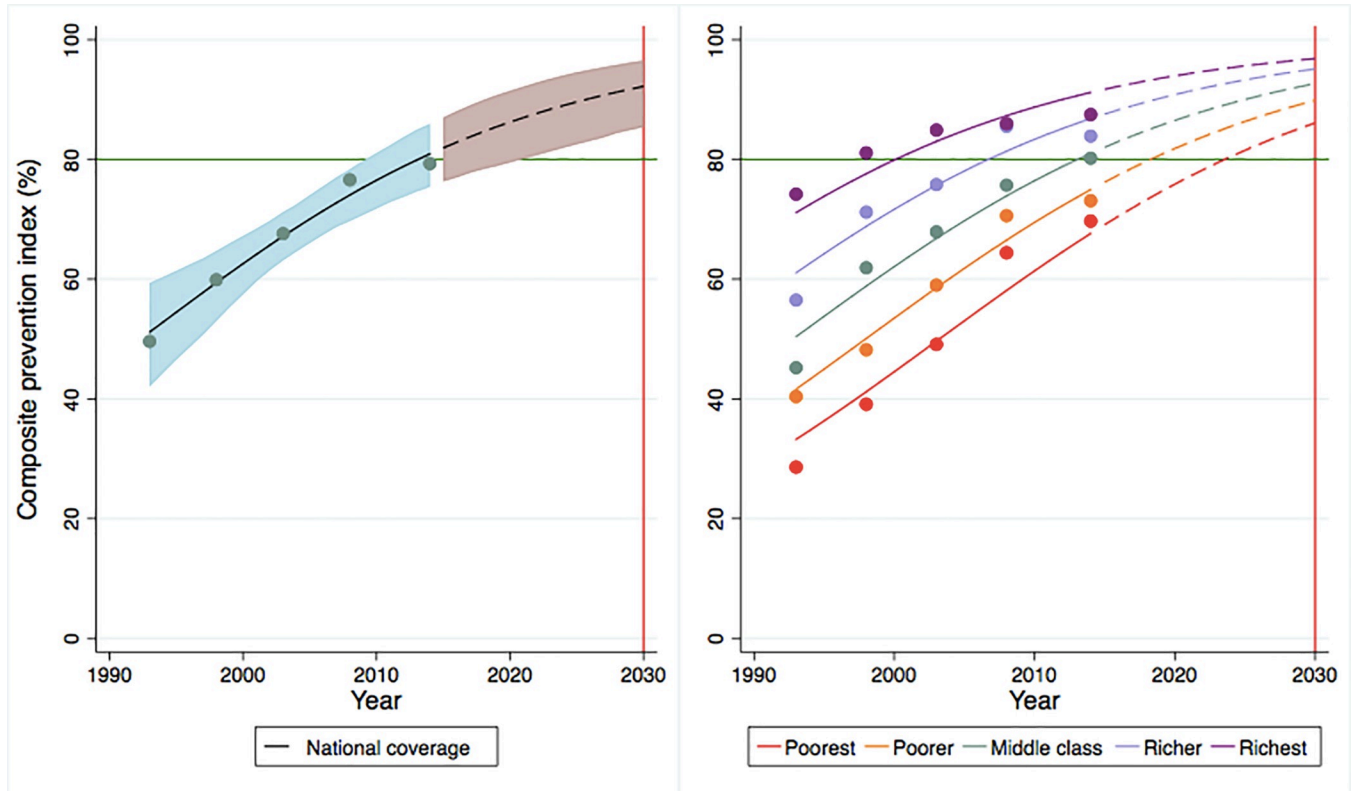
Fig 1. Trends and projections of overall prevention coverage in Ghana, 1993–2030.

https://doi.org/10.1371/journal.pone.0209126.g001

coverage of prevention and treatment services are predicted to reach 92.2% (95% CrI: 85.4–96.5) and 80.3% (95% CrI: 67.7–89.4) by 2030 and all quintiles other than the two poorest quintiles in the treatment index will have high probabilities of achieving the 80% coverage target. Trends and projections in CCI related to reproductive, maternal and child health indicators between 1995 and 2030 estimates that overall national coverage will increase to 80.7% (95%CrI: 77.3–83.9) by 2030 (S7 Table and S1 Fig); however, only the middle class and the richer quintile are predicted to achieve the target. Detailed quintile-specific coverage of all three composite indices with probabilities of reaching the 80% coverage target by 2030 is presented in S7 Table.

Figs 3 and 4 present the trends and projections of prevention and treatment indices across the 10 regions in Ghana from 1995 to 2030. All coverages are shown to have increased and are predicted to continue up to 2030. In 2015, the lowest overall prevention and treatment service coverage were observed in Northern at 71.5% (95%CrI: 67.7–75.2) and 43.9% (95%CrI: 33.2–55.1) respectively, while the highest overall coverage for prevention services was in Greater Accra at 88.5% (95%CrI: 86.5–90.2) and highest overall treatment coverage in Upper East at 79.8% (95%CrI: 71.7–86.4). All regions are predicted to achieve the 80% coverage by 2030 with 100% probabilities for the composite prevention index; however, the same cannot be applied to composite treatment index as four out of the 10 regions are estimated to fail to reach the target, given probabilities less than 80% (S9 Table).

Inequality in service coverage

Table 2 depicts the absolute difference or percentage point difference in the proportion of health service coverage between the extremes of wealth quintiles represented by SII values
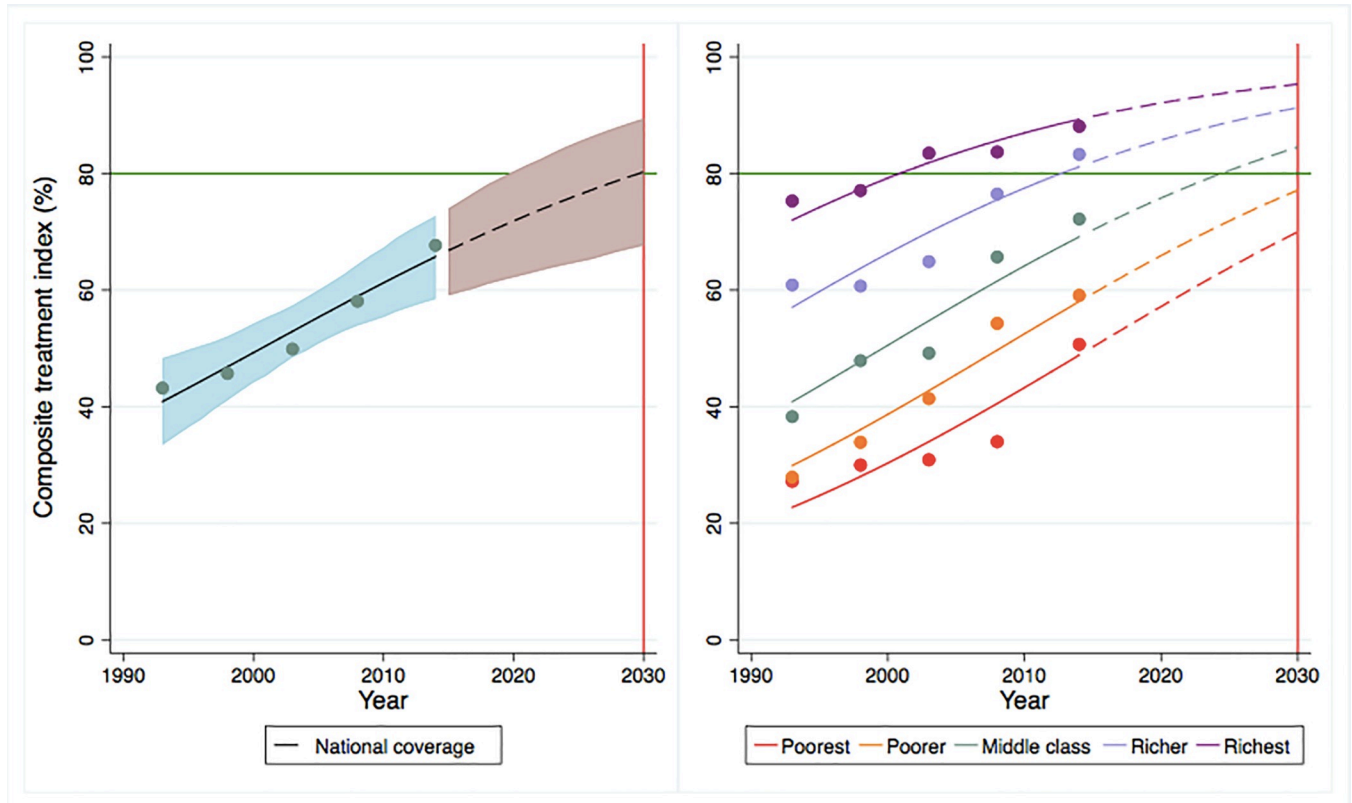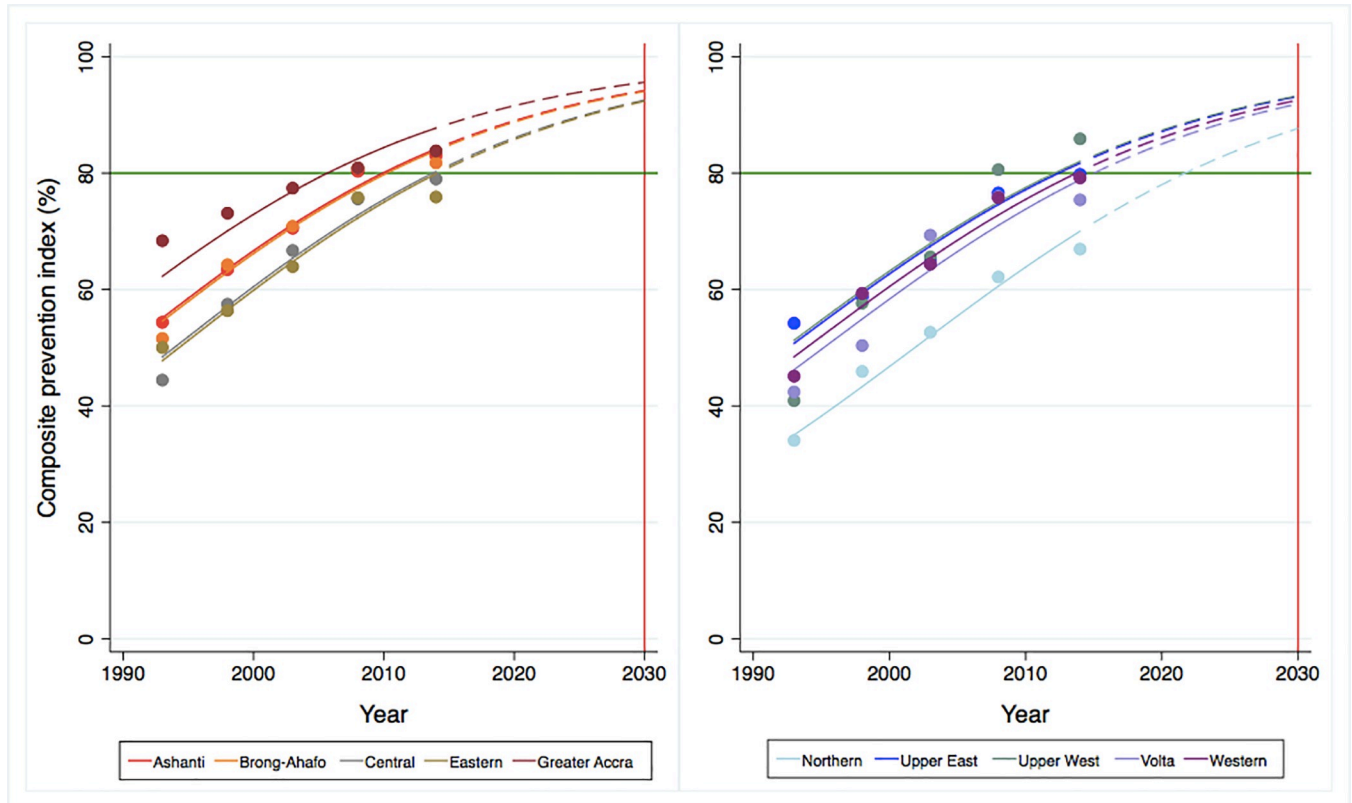
Fig 2. Trends and projections of overall treatment coverage in Ghana, 1993–2030.

along with 95% CrI. Overall, absolute inequalities have drastically decreased across most indicators except for use of skilled birth attendance, institutional delivery, and adequate sanitation in which SII only slightly decreased for skilled birth attendance (SBA) and even increased and is predicted to remain so for institutional delivery and adequate sanitation. These three indicators have the biggest inequalities in 2015 and will likely to prevail up to 2030. Adequate sanitation has a SII of 87.7 (95% CrI: 79.4–93.4), followed by institutional delivery at 87.4 (95% CrI: 77.9–93.6) and skilled birth attendance at 69.9 (95% CrI: 56.6–81.1). These numbers signify that the richest quintile had 69.9 to 87.7 percentage points higher coverage compared to the poor. Although inequalities in indicators related to maternal care such as antenatal and postnatal care have decreased, but persistent inequalities are predicted up to 2030. Similar to absolute inequalities, decreasing trends are also seen and predicted for relative inequalities, represented by RII values, to a lesser degree. By examining current values, it is evident that for most indicators, the richer groups had one to three times more coverage than their poorer counterparts in 2015. Detailed RIIs from 1995 to 2030 is presented in S8 Table.

Financial hardship

Both incidence of CHE and impoverishment drastically decreased since 1995 with an estimated annual rate of reduction at 10.2% (95% CrI: 5.9–14.2) (Table 3). In 1995, 15.0% (95% CrI: 9.6–22.6) of households suffered financial catastrophe as a result of OOP health care payments; however, that proportion is expected to reduce to 0.4% (95%CrI: 0.1–1.3) in 2030. The probability of achieving 100% financial risk protection is estimated to be 96.2%. Proportion of households that experienced impoverishment was 1.7% (95%CrI: 1.1–2.6) in 1995 and is

Fig 3. Trends and projections of overall prevention coverage across regions in Ghana, 1993–2030.

https://doi.org/10.1371/journal.pone.0209126.g003

predicted to reduce to 0.2% (95%CrI: 0.0–0.5) by 2030. Inequality in CHE also decreased since 1995 as shown in Table 4. In 1995, the poorest quintile was suffering 5.4 percentage points more CHE in comparison to the richest quintile. By 2030, that difference is estimated to reduce to 0.1 percentage point.

At the subnational level as represented in Table 5, the proportion of households suffering CHE displays a decreasing trend and all regions are estimated to have extremely low incidence by 2030 with high probabilities of achieving 100% financial risk protection. In 2015, Central region incurred the highest incidence at 2.3% (95% CrI: 1.4–3.5), followed by Volta at 2.1% (95%CrI: 1.3–3.2). At the same time, Brong-Ahafo and Upper East had the highest incidence of impoverishment at 0.8%. Details regarding the incidence of impoverishment for all regions can be found in S10 Table.

Discussion

This paper provides a broad overview of Ghana's progress towards UHC, as it examined both health service coverage and financial risk protection components at the national, subnational, and socio-economic levels. There have been tremendous improvements in increasing access to various health services with upward trends in coverage accompanied by decreasing trends in the proportion of households suffering CHE. The development of Community-based Health Planning and Services (CHPS) targeting primary health care, decentralization, pluralistic health system, and the implementation of NHIS may have contributed to improved coverage of reproductive, maternal, and child health interventions, particularly immunizations [16].
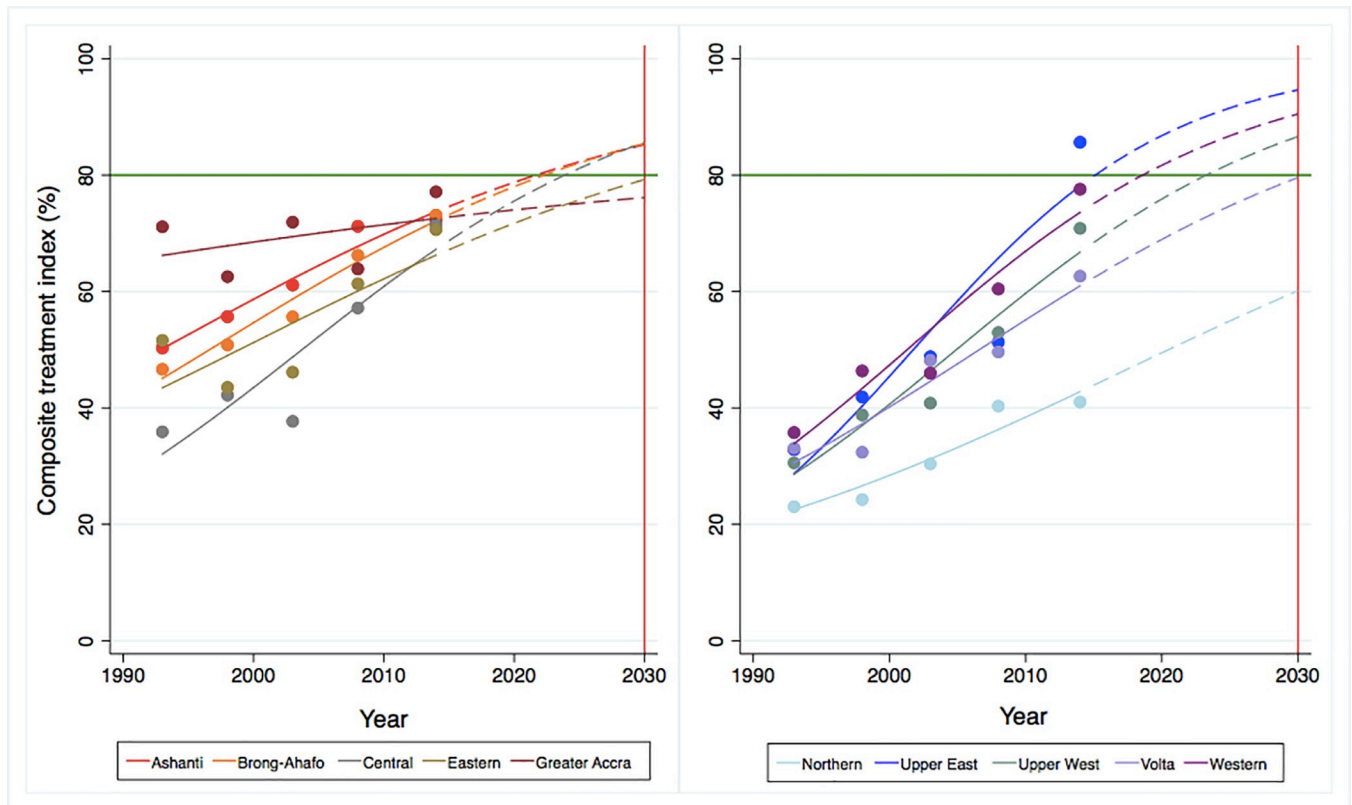
Fig 4. Trends and projections of overall treatment coverage across regions in Ghana, 1993–2030.

However, inequalities still exist for both UHC components throughout the nation. Similarly, subnational disparities were apparent as well with some regions faring better than others.

The greatest achievement is the childhood immunization coverage with all vaccinations already reaching the 80% coverage target in 2015. The government made a strong commitment to finance immunization paying 100% for childhood vaccines. The Expanded Programme on Immunization (EPI) began in 1978 in an attempt to reduce overall poverty by reducing infant and child mortality caused by vaccine preventable diseases [17]. Through community-based strategies, home visits and outreaches, it has evolved to become one of the most successful and cost effective programmes implemented in Ghana [17]. On the contrary, family planning demand satisfied showed the least likelihood of reaching its target. The low uptake of family planning can be explained by many facets such as misconception, stigma, lack of knowledge, religious abhorrence, spousal disapproval, and inaccessibility [18, 19]. Health concerns including fear of side effects remain one of the biggest reasons and a similar finding was reported in Ethiopia as well [20]. Proper teaching is critical and Community Health Workers (CHWs) can greatly improve the use of contraceptives by providing adequate education on its usage and health safety concerns [21]. It should be integrated into existing health education programmes to increase awareness, access, and utilization [18]. Additional interventions include empowering women, improving female education through the free universal secondary school policy, involving male partners, and making contraceptives readily available and affordable.

Findings from the analyses displayed significant improvement in most of the maternal health indicators such as more than four antenatal care visits, postnatal care for mothers,

Table 2. Slope index of inequality (SII) in health service indicators, 1995–2030.

Indicators	SII (95% CrI) (Q5-Q1)[a]			
	1995	2005	2015	2030
Prevention indicators				
Needs for family planning satisfied	20.3 (14.6–27.0)	13.3 (9.7–17.7)	8.8 (4.1–16.4)	5.0 (1.0–15.5)
At least four antenatal care visits	52.2 (45.4–59.5)	40.5 (36.0–45.6)	29.9 (23.1–38.3)	17.8 (9.6–30.9)
Postnatal care for mothers[c]	–	75.9 (57.1–89.6)	54.2 (35.8–70.2)	25.6 (1.4–77.8)
Exclusive breastfeeding	61.5 (40.5–79.5)	13.3 (8.7–18.9)	1.6 (0.4–4.4)	0.1 (0.0–0.5)
Insecticide treated bed nets for children[b]	–	–	–	–
Insecticide treated bed nets for mothers[b]	–	–	–	–
BCG immunization	28.0 (19.8–38.4)	11.2 (8.4–14.7)	4.1 (2.1–7.3)	0.9 (0.2–2.6)
DPT3 immunization	40.7 (30.4–52.2)	14.3 (10.6–18.6)	4.0 (2.1–6.9)	0.6 (0.1–1.6)
Polio3 immunization	39.6 (28.6–51.3)	9.0 (5.8–13.7)	1.6 (-0.5–4.0)	0.1 (0.0–0.6)
Measles immunization	38.4 (29.8–48.2)	15.8 (12.5–19.7)	5.5 (3.2–8.6)	1.1 (0.3–2.7)
Improved water	78.7 (71.6–85.8)	57.4 (39.8–75.0)	32.5 (16.9–48.1)	10.5 (4.2–16.7)
Adequate sanitation	71.0 (59.5–80.5)	80.9 (79.4–93.4)	87.7 (79.4–93.4)	93.4 (81.4–98.4)
No-use of tobacco[c]	–	18.2 (4.4–31.9)	10.5 (2.0–18.9)	4.4 (0.7–8.2)
Treatment indicators				
Institutional delivery	70.9 (58.7–87.1)	80.7 (73.9–85.9)	87.4 (77.9–93.6)	93.0 (79.0–98.5)
Skilled birth attendance	72.5 (62.0–80.9)	71.4 (64.4–77.5)	69.9 (56.6–81.1)	67.0 (40.6–87.7)
Oral rehydration therapy	23.5 (17.8–29.6)	15.3 (12.6–18.4)	9.8 (6.4–14.5)	5.1 (1.9–11.0)
Care seeking for pneumonia	37.0 (26.5–47.8)	26.9 (21.1–32.8)	19.0 (11.4–29.0)	11.3 (3.3–27.9)

Note:

[a]SII = slope index of inequality; Q5 indicates the richest quintile, and Q1 indicates the poorest quintile.

[b]unable to obtain accurate trends due to huge variations in SII values from raw data between survey years.

[c]No data before year 2000. CrI = credible interval; DPT3 = three doses of DPT immunization; Polio3 = three doses of polio immunization.

https://doi.org/10.1371/journal.pone.0209126.t002

Table 3. Trends and projections of the incidence of catastrophic health expenditure and impoverishment in Ghana, 1995–2030.

Year	Catastrophic health expenditure[a] (95% CrI)	Impoverishment (95% CrI)	Financial hardship[b] (95% CrI)
1995	15.0 (9.6–22.6)	1.7 (1.1–2.6)	15.5 (10.1–22.9)
2000	9.0 (6.4–12.7)	1.2 (0.8–1.7)	9.7 (7.0–13.6)
2005	5.4 (3.8–7.3)	0.9 (0.6–1.2)	5.9 (4.2–8.5)
2010	3.2 (2.0–4.9)	0.6 (0.4–0.9)	3.6 (2.2–5.6)
2015	1.9 (0.9–3.5)	0.4 (0.2–0.8)	2.2 (1.1–3.8)
2020	1.1 (0.4–2.4)	0.3 (0.1–0.7)	1.3 (0.5–2.7)
2030	0.4 (0.1–1.3)	0.2 (0.0–0.5)	0.5 (0.1–1.4)
Annual rate of reduction[c]	-10.2 (-14.2 to -5.9)	-6.7 (-10.7 to -2.7)	-9.7 (-13.6 to -6.0)
Probability[d]	96.2%	100%	99.7%

Note

[a]Catastrophic health expenditure was calculated based on the 25% threshold of nonfood consumption

[b]Financial hardship indicates the incidence of catastrophic health expenditures and/or impoverishment

[c]The annual rate of change for the period 1995–2030

[d]Probability = the probability of meeting the target of 100% financial risk protection by 2030 according to WHO's universal health coverage target; CrI = credible interval.

https://doi.org/10.1371/journal.pone.0209126.t003

Table 4. Inequality in catastrophic health expenditure in Ghana, 1995–2030.

Year	Catastrophic health expenditure[a] (95% CrI)		Inequality in catastrophic health expenditure	
	Poorest (Q1)	Richest (Q5)	RII (95% CrI)	SII (95% CrI)
1995	16.4 (11.4–23.7)	11.7 (7.8–16.3)	0.7 (0.6–0.8)	-5.4 (-8.1 to -2.7)
2000	10.0 (7.0–14.2)	7.0 (4.7–9.7)	0.7 (0.5–0.8)	-3.5 (-5.2 to -1.8)
2005	5.9 (4.0–8.4)	4.1 (2.7–5.7)	0.7 (0.5–0.8)	-2.1 (-3.2 to -1.1)
2010	3.4 (2.2–5.0)	2.4 (1.5–3.5)	0.7 (0.5–0.8)	-1.3 (-1.9 to -0.6)
2015	2.0 (1.2–3.0)	1.4 (0.8–2.1)	0.6 (0.5–0.8)	-0.7 (-1.0 to -0.4)
2020	1.1 (0.6–1.8)	0.8 (0.4–1.3)	0.6 (0.5–0.8)	-0.4 (-0.6 to -0.2)
2030	0.4 (0.2–0.7)	0.3 (0.1–0.5)	0.6 (0.5–0.8)	-0.1 (-0.2 to -0.0)
Probability	99.6%	99.7%	–	–

Note: CrI = credible interval; RII = relative index of inequality; SII = slope index of inequality

[a]Catastrophic health expenditure was calculated based on a 525% threshold of nonfood expenditure.

https://doi.org/10.1371/journal.pone.0209126.t004

institutional delivery, and use of skilled birth attendance in part due to accelerated efforts to achieve the MDGs. In particular, more than four antenatal care visits has already reached the 80% target in 2015 at the national level. Another explanation could be attributed to the implementation of NHIS as this insurance allows pregnant women to be exempt from premium with maternity care coverage [22]. In addition, the Maternal Health Program (branded as the free maternal health policy as a part of the NHIS), granted to women upon confirmation of pregnancy and enrollment into the NHIS, completely eliminates OOP payments for six antenatal care visits, delivery care, two postnatal care visits, and infant care up to three months of age [22]. This could be a reason why postnatal care for mothers increased by eight-fold in the span of 10 years from 2005 to 2015. Countries such as Rwanda and Indonesia have also proved that pregnant women who are enrolled into insurance are more likely to utilize various maternal care services such as prenatal care, institutional delivery, skilled birth attendants, postnatal care, and seek vaccinations for their children [22–24]. Therefore, continuous efforts must be made to encourage pregnant women to enroll into the NHIS and to utilize maternal care services.

Table 5. Incidence of catastrophic health expenditure at the subnational level in Ghana, 1995–2030.

Region	Catastrophic health expenditure[a] (95% CrI)				Probablity[b]
	1995	2005	2015	2030	
Ashanti	16.1 (10.5–22.5)	5.9 (3.8–8.6)	2.0 (1.2–3.1)	0.4 (0.2–0.7)	99.5%
Brong-Ahafo	14.6 (9.5–20.3)	5.3 (3.4–7.6)	1.8 (1.1–2.8)	0.4 (0.2–0.6)	100%
Central	17.9 (11.9–24.7)	6.7 (4.3–9.5)	2.3 (1.4–3.5)	0.5 (0.2–0.8)	99.7%
Eastern	15.0 (10.2–21.2)	5.5 (3.6–7.9)	1.9 (1.1–2.9)	0.4 (0.2–0.7)	99.9%
Greater Accra	9.5 (6.2–13.7)	3.3 (2.2–4.9)	1.1 (0.7–1.7)	0.2 (0.1–0.4)	100%
Northern	13.0 (8.6–18.5)	4.7 (3.0–6.8)	1.6 (1.0–2.5)	0.3 (0.2–0.6)	100%
Upper East	9.1 (5.9–13.4)	3.2 (2.1–4.7)	1.1 (0.6–1.7)	0.2 (0.1–0.4)	100%
Upper West	8.4 (5.3–12.5)	2.9 (1.8–4.4)	1.0 (0.6–1.5)	0.2 (0.1–0.3)	100%
Volta	16.3 (11.2–22.9)	6.0 (4.0–8.7)	2.1 (1.3–3.2)	0.4 (0.2–0.7)	99.6%
Western	13.8 (9.1–19.9)	5.0 (3.2–7.2)	1.7 (1.0–2.7)	0.3 (0.2–0.6)	99.9%

Note:

[a]Catastrophic health expenditure was calculated based on 25% threshold of nonfood expenditure

[b]The probability of achieving 100% financial risk protection; CrI: credible interval

https://doi.org/10.1371/journal.pone.0209126.t005

Similarly, care seeking for the treatment of pneumonia also had a low coverage and unlikely to reach the target because a past study conducted in rural Ghana found significant knowledge deficit among residents regarding pneumonia [25]. In that study, only one-third of the studied population ever heard of the disease name and among those, only half sought treatment for their children [25]. It is imperative to increase people's knowledge of childhood illnesses and perhaps the Ministry of Health and Ghana Health Service need to strengthen the health promotion unit to provide structured and targeted community educational programmes by adequately training CHPS Community Health Workers (CHWs). As an additional effort, the EPI in Ghana currently have vaccines against all common causes of pneumonia in children [16]. Enrolling into NHIS can also potentially improve treatment-seeking behavior since parents who are enrolled are more likely to seek curative and preventive care for their children [26].

We also found that utilization of institutional delivery and access to SBA were among the top three indicators with the biggest absolute and relative inequalities in 2015. Our raw data showed that during the 2000s, coverage in these two services decreased for the poorest quintile; thus, widening the inequality gap. This finding is confirmed by a previous study conducted on young Ghanaian women with childbirth history which showed an increased inequality in the use of SBA between 2008 and 2014 [27, 28]. A separate study that examined spatial inequalities of institutional birth revealed that women belonging to poorer households are less likely to give birth in institutions [29]. Financial determinants, physical barriers, conceptions about the quality of services, availability of human resources, and social barriers can all have an impact on the use of institutional delivery and SBA [30, 31]. Several studies have found that wealthier and more educated women are more likely to enroll into the NHIS and seek maternal care services [22, 24, 32]. Many uneducated women from poor households lack the basic knowledge about maternal health [27]. A previous study conducted by Ganle et al revealed that increasing women's general level of education can also promote the use of maternal health services; therefore, the government should invest in schooling of young women [33]. Ghana is in the right direction to achieving universal health care as there is a quest to provide free education from basic to secondary school level by the national government. Keeping girls in school for longer is one key way to enhance maternal health and promote safe motherhood. The CHPS concept can boost access to reproductive health services especially for the rural poor as CHWs who work at the CHPS level have proven to be effective in improving health care access and overall health status [34, 35].

The study found wealth quintile based differences in coverage among most health service indicators. Access to services is determined by health system factors as well as individual, household, and community level factors [36]. The rich often reside in urban areas with more accessibility, better infrastructure, and adequate human resources to allow access to health services [36]. They can also more readily afford financial costs of services and the persisting out-of-pocket payment for certain services outside the benefits package of the NHIS. If health services cannot reach the poor, there is an increased likelihood of illnesses resulting in worse health status and further impoverishment. This will not only widen inequality gap but also drifts away from UHC goals. Extra efforts are needed to narrow this gap and increase access to maternal health services for the poor (as Ghana failed to achieve MDG 4 and 5).

In addition to quintile-based differences, geographical inequalities also prevailed. The Northern region lagged significantly behind all other regions in prevention and treatment coverage. This could be explained by the fact that this region occupies about a third of the landsize of Ghana, and has the lowest doctor-to-population and nurse-to-population ratios, making health services more difficult to obtain [22]. Furthermore, this region is the biggest contributor to poverty in Ghana [37], and poorer regions tend to have sparse service provision, weak infrastructure, and challenges with transportation, which greatly impact access to health

care [38]. Overall, regional specific strategies (administrative and social policy) will be needed. As an extra attempt to tackle regional disparities, Ghana has recently divided the Northern region into three different administrative regions to enhance decentralization of fiscal and administrative policy to overcome the specific challenges already highlighted for the region.

In addition to current national efforts, including direct budgetary support to the CHPS and promoting the partnership with One Million CHW Campaign will be key [34]. The national EPI's adoption of the Reaching Every District and Reach Every Child approaches [39], which has proven to be successful in increasing immunization coverage can also be extended to other health services. Wealth, education, employment, and location play critical roles in health service coverage, thus concerted national and sub-national efforts are needed as part of the national developmental agenda to improve coverage [40].

Financial catastrophe due to healthcare spending decreased by almost eight-fold from 1995 to 2015 and impoverishment witnessed a four-fold decrease. From our data, it is evident that expenditure on non-food items drastically increased. The number of non-food items in Ghana Living Standard Surveys conducted in 2012–2013 tripled compared to the survey conducted in 1991–1992; therefore, health expenditure as a percentage of non-food expenditure decreased over the years, lowering the proportion of household suffering catastrophic expenditure. Although inequality gaps have narrowed as difference in the incidence of financial catastrophe between the rich and the poor groups reduced, the poor is still suffering more CHE as a result of OOP health payment. This finding is in congruence with previous studies from other Sub-Saharan African countries [41–43]. At a threshold of 25% non-food expenditure, incidence of CHE was 1.8% in 2015 and 0.4% of households were pushed into poverty. These results were worse compared to earlier studies done in South Africa and Tanzania in which impoverishment were only 0.045% and 0.37%, respectively in 2008 [42]. On a positive note, Ghana's progress was shown to be better than Rwanda and Nigeria [43–45].

Despite the implementation of NHIS, many opportunistic costs are associated with health care services such as expense for transportation, diagnostics tests, and medication [33]. This study included expenditure on diagnostic tests and medication as part of the OOP health payment. Recall from earlier section that CHE is defined as total OOP health payments exceeding 25% of non-food expenditure. As households in lower wealth quintiles spend less on non-food items compared to the rich, their health expenditures are more likely to exceed the 25% of non-food expenditure threshold, leading to higher proportion of households suffering CHE. A recent study done in Ghana revealed that as share of OOP payment for healthcare in total household expenditure increases, impoverishment deepens [46]. Reducing OOP payment for healthcare, especially for the poor, is essential as it is a determining factor of impoverishment. Overall, UHC policy has proven to greatly contributes to the reduction of catastrophic payments [47].

Previous studies conducted in Ghana regarding the protective effect of NHIS revealed that the incidence and the intensity of CHE were greatly reduced in insured individuals especially for the poor [48, 49]. It proved to have protective mechanism against financial shocks with a 67% reduction in OOP and reduces the likelihood of foregoing other subsistent needs for health care [48]. It is recommended that Ghana to continue with its current progress by further enrolling all citizens into the scheme. There is a need to explore other funding options to ensure sustainability of NHIS as well as to further lower premium for the poor and vulnerable population. Thailand sets a great example in establishing equity through its insurance scheme by subsidizing tax for the poor instead of premium contribution [50]. It is believed that free health care for all is achievable and affordable in Ghana via cost savings, progressive taxation, and high quality transparent aid [51].

Strengths and limitations

One of the major strengths of this study is that it systematically examined both health service coverage and financial risk protection. It also provided trends and future projections for chosen indicators. Furthermore, subnational analysis yielded further detailed assessment. Few accompanied limitations include missing information prior to 2000 for some of the indicators, the inability to make projections for NCD and HIV related indicators, and the inability to capture information for those that are too poor to utilize healthcare.

Conclusion

Ghana with its strenuous efforts in making health care more equitable and affordable has made tremendous improvements in health service coverage along with reducing OOP payment. Rigorous health policy implementation, attempts in achieving the MDGs, and the establishment of the NHIS resulted in significant improvement in maternal and child health indicators. However, apparent inequalities were evident at the national and subnational level since the poor were suffering more catastrophic health expenditure (CHE) and had less access to health services. These inequalities were observed in many studies conducted in Ghana thus far. Policy makers need to make stronger commitments in achieving equity as many health care interventions, aimed at the poor, do not reach them. Poverty, unavailability of services, inadequate infrastructure, insufficient human resources, social norms, and limited education and health knowledge are potential contributing factors to inequities.

Several options to be considered are equitably distribute funds to regions according to needs, administrative re-organization of some regions, increase enrollment unto NIHS, scale up of the CHPS programme to improve access to hard-to-reach population along with raising the quality of care, increase the capacity of human resources, and improve health infrastructure. Ghana serves as an example for other Sub-Saharan African countries in implementing a universal health insurance. Its achievement in improving health care utilization for its citizens and reducing financial burdens is praiseworthy. This study recommends a multi-sectoral approach to address economic, social, and political barriers through partnership between the Ministry of Health and its agencies including Ghana Health Service and other service delivery agencies and development partners. By doing so, UHC will no longer be a distant dream.

Supporting information

S1 Appendix. Supplementary appendix.
(DOCX)

S1 Table. Health service indicators.
(DOCX)

S2 Table. Deviance information criteria for health service indicators.
(DOCX)

S3 Table. Quintile-specific coverage of reproductive, maternal, and child health services in Ghana, 1995–2030.
(DOCX)

S4 Table. Quintile-specific vaccination coverage in Ghana, 1995–2030.
(DOCX)

S5 Table. Quintile specific coverage of disease prevention and environmental health indicators in Ghana, 1995–2030.
(DOCX)

S6 Table. Quintile specific coverage of treatment services for delivery care and childhood illnesses in Ghana, 1995–2030.
(DOCX)

S7 Table. Quintile-specific coverage of composite indices for health services in Ghana, 1995–2030.
(DOCX)

S8 Table. Relative index of inequalities (RII) in health service indicators, 1995–2030.
(DOCX)

S9 Table. Overall prevention and treatment service coverage at the subnational level in Ghana, 1995–2030.
(DOCX)

S10 Table. Impoverishment at the subnational level in Ghana, 1995–2030.
(DOCX)

S11 Table. Survey characteristics.
(DOCX)

S1 Fig. Trends and projections of composite coverage index in Ghana, 1993–2030.
(PDF)

S2 Fig. Trends and projections of the coverage of insecticide treated bed nets for children under five and pregnant women in Ghana, 2003–2030.
(PDF)

S3 Fig. Trends and projections of the coverage of antenatal and postnatal care for women in Ghana, 1993–2030.
(PDF)

S4 Fig. Trends and projections of the coverage of family planning needs satisfied and exclusive breastfeeding in Ghana, 1993–2030.
(PDF)

S5 Fig. Trends and projections of the coverage of delivery care services in Ghana, 1993–2030.
(PDF)

S6 Fig. Trends and projections of the coverage of measles and polio vaccination in Ghana, 1993–2030.
(PDF)

S7 Fig. Trends and projections of the coverage of BCG and DPT vaccination in Ghana, 1993–2030.
(PDF)

S8 Fig. Trends and projections of the coverage of treatment services for childhood illnesses in Ghana, 1993–2030.
(PDF)

S9 Fig. Trends and projections of the coverage of environmental health indicators in Ghana, 1993–2030.
(PDF)

S10 Fig. Trends and projections of non-tobacco users in Ghana, 2003–2030.
(PDF)

Acknowledgments

Author Contributions

Conceptualization: Cherri Zhang, Md. Mizanur Rahman, Kenji Shibuya.

Data curation: Cherri Zhang, Md. Mizanur Rahman.

Formal analysis: Cherri Zhang.

Methodology: Cherri Zhang, Md. Shafiur Rahman, Md. Mizanur Rahman, Kenji Shibuya.

Software: Cherri Zhang, Md. Shafiur Rahman.

Supervision: Md. Mizanur Rahman, Kenji Shibuya.

Validation: Cherri Zhang, Md. Shafiur Rahman, Md. Mizanur Rahman.

Visualization: Cherri Zhang, Md. Shafiur Rahman.

Writing – original draft: Cherri Zhang.

Writing – review & editing: Cherri Zhang, Md. Mizanur Rahman, Alfred E. Yawson, Kenji Shibuya.

References

1. World Health Organization. Tracking universal health coverage: First Global Monitoring Report. Geneva, Switzerland: WHO Press;2015.

2. Boerma JT, Eozenou P, Evans D, Evans T, Kieny M-P, Wagstaff A. Monitoring progress towards universal health coverage at country and global lebels. PLoS Med. 2014; 11(9).

3. United Nations General Assembly. Transforming our world: The 2030 Agenda for Sustainable Development. New York, United States of America: United Nations;2015.

4. World Bank. UHC in Africa: A framework for action. Washington, DC: World Bank Group; 2016.

5. Carapinha JL, Ross-Degnan D, Desta AT, Wagner AK. Health insurance systems in five Sub-Saharan African countries: medicine benefits and data for decision making. Health Policy. 2011; 99(3):193–202. https://doi.org/10.1016/j.healthpol.2010.11.009 PMID: 21167619

6. Akazili J, Garshong B, Aikins M, Gyapong J, McIntyre D. Progressivity of health care financing and incidence of service benefits in Ghana. Health Policy Plan. 2012.

7. Alhassan RK, Nketiah-Amponsah E, Arhinful DK. A review of the National Health Insurance Scheme in Ghana: What are the sustainability threats and prospects? PLoS One. 2016; 11(11).

8. Amporfu E. Equity of the premium of the Ghanaian National Health Insurance Scheme and the implications for achieving universal coverage. International journal for equity in health. 2013; 12:4. https://doi.org/10.1186/1475-9276-12-4 PMID: 23294982

9. Aryeetey GC, Westeneng J, Spaan E, Jehu-Appiah C, Agyepong IA, Baltussen R. Can health insurance protect against out-of-pocket and catastrophic expenditures and also support poverty reduction?

Evidence from Ghana's National Health Insurance Scheme. International journal for equity in health. 2016; 15(1):116. https://doi.org/10.1186/s12939-016-0401-1 PMID: 27449349

10. World Bank. Data Bank: World development indicators. Available from: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

11. Barros AJ, Victora CG. Measuring coverage in MNCH: determining and interpreting inequalities in coverage of maternal, newborn, and child health interventions. PLoS Med. 2013; 10(5):e1001390. https://doi.org/10.1371/journal.pmed.1001390 PMID: 23667332

12. Boerma JT, Bryce J, Kinfu Y, Axelson H, Victora CG. Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries. Lancet. 2008; 371 (9620):1259–67. https://doi.org/10.1016/S0140-6736(08)60560-7 PMID: 18406860

13. Deaton A, Zaidi S. Guidelines for Constructing Consumption Aggregates for Welfare Analysis. World Bank Publications; 2002.

14. Xu K, Aguilar A, Carrin G, Evans D, Hanvoravongchai P, Kawabata K, et al. Distribution of health payments and catastrophic expenditures Methodology. Geneva, Switzerland: World Health Organization; 2005.

15. Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. Arch Public Health. 2014; 72(1):39. https://doi.org/10.1186/2049-3258-72-39 PMID: 25810908

16. Government of Ghana. Comprehensive multi-year plan for immunization (2015–2019). 2014. Available from: http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_repository/ghana/ghana_cmyp_2015-2019.pdf

17. Ministry of Health, Ghana Health Services. Immunization programme comprehensive multi-year plan (2010–2014). 2011. Available from: http://www.nationalplanningcycles.org/sites/default/files/country_docs/Ghana/revised_cmyp_2010_-_2014.pdf

18. Prata N. Making family planning accessible in resource-poor settings. Philos Trans R Soc Lond B Biol Sci. 2009; 364(1532):3093–9. https://doi.org/10.1098/rstb.2009.0172 PMID: 19770158

19. Enuameh YA, Okawa S, Asante KP, Kikuchi K, Mahama E, Ansah E, et al. Factors Influencing Health Facility Delivery in Predominantly Rural Communities across the Three Ecological Zones in Ghana: A Cross-Sectional Study. PLoS One. 2016; 11(3):e0152235. https://doi.org/10.1371/journal.pone.0152235 PMID: 27031301

20. Korra A. Attitudes toward family planning, and reasons for nonuse among women with unmet need for family planning in Ethiopia. Calverton, Maryland: ORC Macro; 2002.

21. Foreit J RS. Increasing access to Family Planning (FP) and Reproductive Health (RH) services through task-sharing between Community Health Workers (CHWs) and community mid-level professionals in large-scale public-sector programs. Population Council. 2011.

22. Singh K, Osei-Akoto I, Otchere F, Sodzi-Tettey S, Barrington C, Huang C, et al. Ghana's National Health insurance scheme and maternal and child health: a mixed methods study. BMC Health Serv Res. 2015; 15:108. https://doi.org/10.1186/s12913-015-0762-y PMID: 25889725

23. Blanchet NJ, Fink G, Osei-Akoto I. The Effect of Ghana's National Health Insurance Scheme on Health Care Utilization. Ghana Medical Journal. 2012; 46(2):9.

24. Wang W, Temsah G, Mallick L. The impact of health insurance on maternal health care utilization: evidence from Ghana, Indonesia and Rwanda. Health Policy Plan. 2017; 32(3):366–75. https://doi.org/10.1093/heapol/czw135 PMID: 28365754

25. Abbey M, Chinbuah MA, Gyapong M, Bartholomew LK, van den Borne B. Community perceptions and practices of treatment seeking for childhood pneumonia: a mixed methods study in a rural district, Ghana. BMC Public Health. 2016; 16(1):848. https://doi.org/10.1186/s12889-016-3513-z PMID: 27549163

26. Gajate-Garrido G, Owusua R. The National Health Insurance Scheme in Ghana: Implementation Challenges and Proposed Solutions. International Food Policy Research Institute; 2013.

27. Asamoah BO, Agardh A. Inequality trends in maternal health services for young Ghanaian women with childbirth history between 2003 and 2014. BMJ Open. 2017; 7(2):e011663. https://doi.org/10.1136/bmjopen-2016-011663 PMID: 28174219

28. Joseph G, da Silva ICM, Barros AJD, Victora CG. Socioeconomic inequalities in access to skilled birth attendance among urban and rural women in low-income and middle-income countries. BMJ Glob Health. 2018; 3(6):e000898. https://doi.org/10.1136/bmjgh-2018-000898 PMID: 30588340

29. Johnson FA, Padmadas SS, Brown JJ. On the spatial inequalities of institutional versus home births in Ghana: a multilevel analysis. J Community Health. 2009; 34(1):64–72. https://doi.org/10.1007/s10900-008-9120-x PMID: 18830808

30. Speizer IS, Story WT, Singh K. Factors associated with institutional delivery in Ghana: the role of decision-making autonomy and community norms. BMC Pregnancy Childbirth. 2014; 14:398. https://doi.org/10.1186/s12884-014-0398-7 PMID: 25427853

31. Apanga PA A-WJ. Improving Skilled Birth Attendance in Ghana: An Evidence-Based Policy Brief. Journal of Health Care for the Poor and Underserved. 2017; 28(3):11.

32. Bonfrer I, Breebaart L, Van de Poel E. The Effects of Ghana's National Health Insurance Scheme on Maternal and Infant Health Care Utilization. PLoS One. 2016; 11(11):e0165623. https://doi.org/10.1371/journal.pone.0165623 PMID: 27835639

33. Ganle JK, Parker M, Fitzpatrick R, Otupiri E. Inequities in accessibility to and utilisation of maternal health services in Ghana after user-fee exemption: a descriptive study. International journal for equity in health. 2014; 13:89. https://doi.org/10.1186/s12939-014-0089-z PMID: 25388288

34. Baatiema L, Sumah AM, Tang PN, Ganle JK. Community health workers in Ghana: the need for greater policy attention. BMJ Glob Health. 2016; 1(4):e000141. https://doi.org/10.1136/bmjgh-2016-000141 PMID: 28588981

35. Yeji F, Shibanuma A, Oduro A, Debpuur C, Kikuchi K, Owusu-Agei S, et al. Continuum of Care in a Maternal, Newborn and Child Health Program in Ghana: Low Completion Rate and Multiple Obstacle Factors. PLoS One. 2015; 10(12):e0142849. https://doi.org/10.1371/journal.pone.0142849 PMID: 26650388

36. Dalinjong PA, Wang AY, Homer CSE. Has the free maternal health policy eliminated out of pocket payments for maternal health services? Views of women, health providers and insurance managers in Northern Ghana. PLoS One. 2018; 13(2):e0184830. https://doi.org/10.1371/journal.pone.0184830 PMID: 29389995

37. Ghana Statistical Services, Ghana Health Services. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: ICF International; 2015.

38. Gething PW, Johnson FA, Frempong-Ainguah F, Nyarko P, Baschieri A, Aboagye P, et al. Geographical access to care at birth in Ghana: a barrier to safe motherhood. BMC Public Health. 2012; 12:991. https://doi.org/10.1186/1471-2458-12-991 PMID: 23158554

39. Ryman T, Macauley R, Nshimirimana D, Taylor P, Shimp L, Wilkins K. Reaching every district (RED) approach to strengthen routine immunization services: evaluation in the African region, 2005. J Public Health (Oxf). 2010; 32(1):18–25.

40. Onarheim KH, Taddesse M, Norheim OF, Abdullah M, Miljeteig I. Towards universal health coverage for reproductive health services in Ethiopia: two policy recommendations. International journal for equity in health. 2015; 14:86. https://doi.org/10.1186/s12939-015-0218-3 PMID: 26419910

41. Akazili J, McIntyre D, Kanmiki EW, Gyapong J, Oduro A, Sankoh O, et al. Assessing the catastrophic effects of out-of-pocket healthcare payments prior to the uptake of a nationwide health insurance scheme in Ghana. Glob Health Action. 2017; 10(1):1289735. https://doi.org/10.1080/16549716.2017.1289735 PMID: 28485675

42. Mills A, Ataguba JE, Akazili J, Borghi J, Garshong B, Makawia S, et al. Equity in financing and use of health care in Ghana, South Africa, and Tanzania: implications for paths to universal coverage. Lancet. 2012; 380(9837):8.

43. Onwujekwe O, Hanson K, Uzochukwu B. Examining inequities in incidence of catastrophic health expenditures on different healthcare services and health facilities in Nigeria. PLoS One. 2012; 7(7):e40811. https://doi.org/10.1371/journal.pone.0040811 PMID: 22815828

44. Lu C, Chin B, Lewandowski JL, Basinga P, Hirschhorn LR, Hill K, et al. Towards universal health coverage: an evaluation of Rwanda Mutuelles in its first eight years. PLoS One. 2012; 7(6):e39282. https://doi.org/10.1371/journal.pone.0039282 PMID: 22723985

45. Onoka CA, Onwujekwe O, Hanson K, Uzochukwu BS. Examining catastrophic health expenditures at variable thresholds using household consumption expenditure diaries. Trop Med Int Health. 2011; 16(10):8.

46. Akazili J, Ataguba JE, Kanmiki EW, Gyapong J, Sankoh O, Oduro A, et al. Assessing the impoverishment effects of out-of-pocket healthcare payments prior to the uptake of the national health insurance scheme in Ghana. BMC Int Health Hum Rights. 2017; 17(1):13. https://doi.org/10.1186/s12914-017-0121-7 PMID: 28532403

47. Somkotra T, Lagrada LP. Payments for health care and its effect on catastrophe and impoverishment: experience from the transition to Universal Coverage in Thailand. Soc Sci Med. 2008; 67(12):2027–35. https://doi.org/10.1016/j.socscimed.2008.09.047 PMID: 18952336

48. Nguyen HT, Rajkotia Y, Wang H. The financial protection effect of Ghana National Health Insurance Scheme: evidence from a study in two rural districts. International journal for equity in health. 2011; 10:4. https://doi.org/10.1186/1475-9276-10-4 PMID: 21247436

49. Kusi A, Hansen KS, Asante FA, Enemark U. Does the National Health Insurance Scheme provide financial protection to households in Ghana? BMC Health Serv Res. 2015; 15(1):12.

50. Prakongsai P, Limwattananon S, Tangcharoensathien V. The equity impact of the universal coverage policy: lessons from Thailand. Adv Health Econ Health Serv Res. 2009; 21:57–81. PMID: 19791699

51. Apoya P, Marriott A. Achieving a Shared Goal: Free Universal Health Care in Ghana. 2011.