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ORIGINAL ARTICLE

Disparities in maternal health services in sub-Saharan Africa

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Abstract

Objectives To examine the progress of and disparities in the provision of key maternal health services in the sub-Saharan Africa (SSA) region.

Methods A time-trend analysis of disparities in antenatal care (ANC) and skilled birth attendance (SBA) coverage in SSA over the last 25 years was conducted. The average values of each country's 5-year period data were used for analysis. Absolute and relative disparities were examined by time period, economic class, geographic group and clusters. Analysis of variance was used to compare progresses in coverage across time.

Results Regional median ANC coverage and SBA increased by 8% points and 15% points, respectively, during the 25-year period. The rank score of SBA has shown significant improvement only in the recent period. A 33.3% disparity between ANC and SBA was observed in the most recent period. The relative disparity by economic class and cluster was higher for SBA than ANC coverage.

Conclusions The region showed improvement in both indicators across time. Regional disparity in ANC narrowed down while that of SBA remained high. These were mainly associated with economic class and cluster of countries.

Keywords Antenatal care · Skilled birth attendance · Disparity · Sub-Saharan Africa

Introduction

Health disparity is the quantity that separates groups from a specified reference point on a particular measure of health that is expressed in terms of rate, percentage, mean, or some other quantitative measures (Keppel et al. 2005). Significant and persistent health differences exist among and within countries, sub-regions, economic groups, race, and ethnic groups across the world. Health difference also exist in individuals' ability to access adequate or quality healthcare (Health and Services 2000; Danso 2007; Marmot 2005; Murray et al. 1999; Omran 2005). However, not all health differences are health disparities. For instance, it is expected that health worsens among elderly compared to young adults (Braveman 2014). Disparity is the most important determinant of health status that could potentially be shaped by policies (Braveman 2006). Its complement and equity, is the absence of systematic disparities in health (Braveman and Gruskin 2003). Achieving health equity requires valuing everyone equally with focused and ongoing societal efforts to address injustices and to eliminate health and healthcare disparities (National Partnership for Action 2011).

The sub-Saharan Africa (SSA) region has the highest maternal morbidity and mortality which contributed a sizable portion of burden of disease in the region. Moreover, there is a notable disparity in the coverage of maternal health services. Therefore, improving maternal health in the SSA region is a key intervention for many health-related problems (Filippi et al. 2006). In this regard, the health systems have the responsibility to reduce disparities in maternal health by preferentially improving the health of the worse-off. As indicated by the World Health Organization (WHO) assessment, almost all SSA countries have policies targeted maternal health services (World

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Health Organization 2000, 2016). Countries have made significant achievements on maternal health millennium development goals (MDGs); however, the progress has been uneven, and disparity remains high-leaving significant gaps. Then, the MDGs' successor, the sustainable development goals (SDGs), includes goals that target reducing disparity (Alkenbrack et al. 2015; United Nations 2015a, b).

Antenatal care (ANC) and skilled birth attendance (SBA) coverage are among the recommended maternal health indicators suggested by the WHO to monitor progress towards the goals of a global strategy (World Health Organization n.d.). As every pregnancy faces risks, all women need access to quality maternal health services during pregnancy and should be assisted by a skilled professional during delivery. ANC enhances SBA services, whereas SBA is a critical factor for reducing maternal mortality (Starrs 2006); however, SSA has had the lowest rate of ANC and SBA coverage (United Nations 2014) and has the highest maternal mortality (United Nations 2015a). Although the region's coverage is poor compared to other regions, this is not uniform across its countries as they are at different stages of economic, demographic, and epidemiologic transitions as well as geo-political advances that may affect the variability of maternal health status development (Barros et al. 2012; Silal et al. 2012).

To our knowledge, regional and sub-regional material health disparities across time have not been conducted taking all countries into consideration. The aim of this study was to evaluate the progress of and disparity in ANC and SBA coverage in the SSA region and the sub-regions/groups over a 25-year period.

Methods

Study design

This study was a time-trend analysis of ANC and SBA coverage in all SSA countries. ANC, in this study indicates, at least one ANC visit in the course of the pregnancy and SBA refers percentage of live births assisted by skilled health personnel. Countries were considered individually and in groups. Analysis was undertaken of data from a 25-year period, from 1990 to 2014.

Data sources and indicators

Data were abstracted from the World Development Indicators (WDI) database (World Bank 2015). This database is compiled from officially recognized international sources and presents the most accurate global development data. It mainly uses data from the demographic and health survey (DHS) and other reliable sources such as the national health system. Terms and condition associated with the data were followed while accessing the datasets. ANC and SBA indicators were selected as both are relevant to maternal health and have relatively complete data.

Grouping of countries by geography, economic class and cluster

Geography

Based on the United Nations (UN) geographic categorization (United Nations 2013), we grouped the SSA countries into four; namely eastern, central, western and southern (Online Resource 1).

Economic class

We used the 2015 World Bank income grouping to categorize countries into lower- or middle-income classes (Online Resource 1).

Cluster

We used hierarchical cluster analysis using Ward's method (Murtagh and Legendre 2011) to group countries with comparatively similar performance in each indicator and period. The agglomeration schedule and dendrogram was used to decide on the number of clusters per indicator per period. Of the 47 SSA countries, Seychelles, the only high-income country, was excluded from analysis as it had extreme values.

Time trend

To ensure consistency in approach for all countries, the 25-year data were categorized into 5-year periods and the average value (when more than one data point) of each 5-year period was taken as the typical point estimate for each country.

Types and forms of disparity

To measure the disparity among countries and regions, four analytic issues need to be clarified: the reference point, how the disparity is measured (in absolute or relative terms), whether it is measured in terms of favourable or adverse events and the way it is summarized across the sub-groups (CDC 2010). We considered five categories of disparity to assess both absolute and relative disparities among countries along different periods.

Overall (SSA) disparity

This indicates the disparity between the best and least performing countries in the region.

Geographic disparity

This indicates the disparity among each of the four geographic groups of the region.

Economic class disparity

This shows the disparity between lower- and middle-income classes.

Cluster disparity

This indicates disparity among different clusters of countries based on their ANC and SBA coverage.

Service disparity

This shows the disparity across the continuum of care, i.e., between *ANC* and *SBA coverages.*

Data analyses, interpretation and measures of disparity

The 25-year ANC and SBA data for each country was exported to IBM SPSS Statistics Version 24 for coding and merging. Data analyses were done by SPSS and Tableau desktop 9.2. We used mean and standard deviation (SD) for normally distributed data and median with IQR for skewed data to determine the overall regional and sub-regional progress. A repeated measure ANOVA technique or its equivalent nonparametric test (Freidman's test) was used to compare coverage among groups of countries over time. Group disparities in each period were compared using one-way ANOVA or nonparametric Kruskal–Wallis test. Standard error of the mean (SEM) was used as a measure of precision. Appropriate tests of assumptions such as normality, outliers, sphericity and homogeneity were conducted before running the respective statistical tests (Martin and Bridgmon 2012; Nordstokke and Zumbo 2010).

Group ANC and SBA values were represented by the unweighted mean, the weighted (to population size) mean and the median values. To compare country level and group (geographic, economic or cluster) coverage, we used the following suggested disparity measures (Evans et al. 2001; Harper and Lynch 2007; Keppel et al. 2005; Pearcy and Keppel 2002).

Absolute disparity measures

1. *Rate difference* (RD = $r_i - r_{ref}$) is a simple arithmetic difference between groups and the least performing reference point (r_{ref}).
2. *Between group variance* (BGV) is a weighted difference between the groups [BGV = $\sum_{j=1}^{J} p_j(y_j - \mu)^2$, where p_j is the group j's population size, y_j is the group j's ANC/SBA coverage and μ is the the region's ANC/SBA mean coverage].

Relative disparity measures

1. *Rate ratio* (RR = r_i/r_{ref}) is a relative difference from the reference point.
2. *Coefficient of variation* (CV = SD/mean) indicates the spread/dispersion.
3. *Index of disparity* ($ID_{isp} = \left(\sum_{j=1}^{J} |r_j - r_{ref}|J\right)/r_{ref} \times 100$) is a summed difference of the groups from the reference point as a percentage of the reference point; where r_j and r_{ref} indicate ANC/SBA coverages in the jth and the reference group, respectively, and J stands for the number of groups compared. While comparing only two groups, ID_{isp} is the same as percentage difference [PD = $(r_i - r_{ref})/r_{ref}) \times 100$].

Both numeric and graphic methods were used to describe the changes and level of regional and group disparities over time.

Results

Regional progress and disparity

Antenatal care (ANC)

The overall median ANC coverage in the SSA region increased by 8% points during the study period, an increase from 81% in 1995–1999 to 89% in 2010–2014. The distribution, however, has been uneven as indicated by the skewness. It was moderately skewed during 1990–1994 (SK = − 0.95) and 1995–1999 (SK = − 0.91) and progressed to highly skewed during 2004–2009 (SK = − 1.97) and 2010–2014 (SK = − 1.70). For these countries with data in each period, the skewness ranged from − 1.1 in 1990–1994 to 1.5 in 2010–2014. The distribution of ANC coverage for all countries in the region and the nine countries with data across the five periods is shown in Fig. 1a, b, respectively. The five 5-year data values of each country are displayed in Online Resource 1.

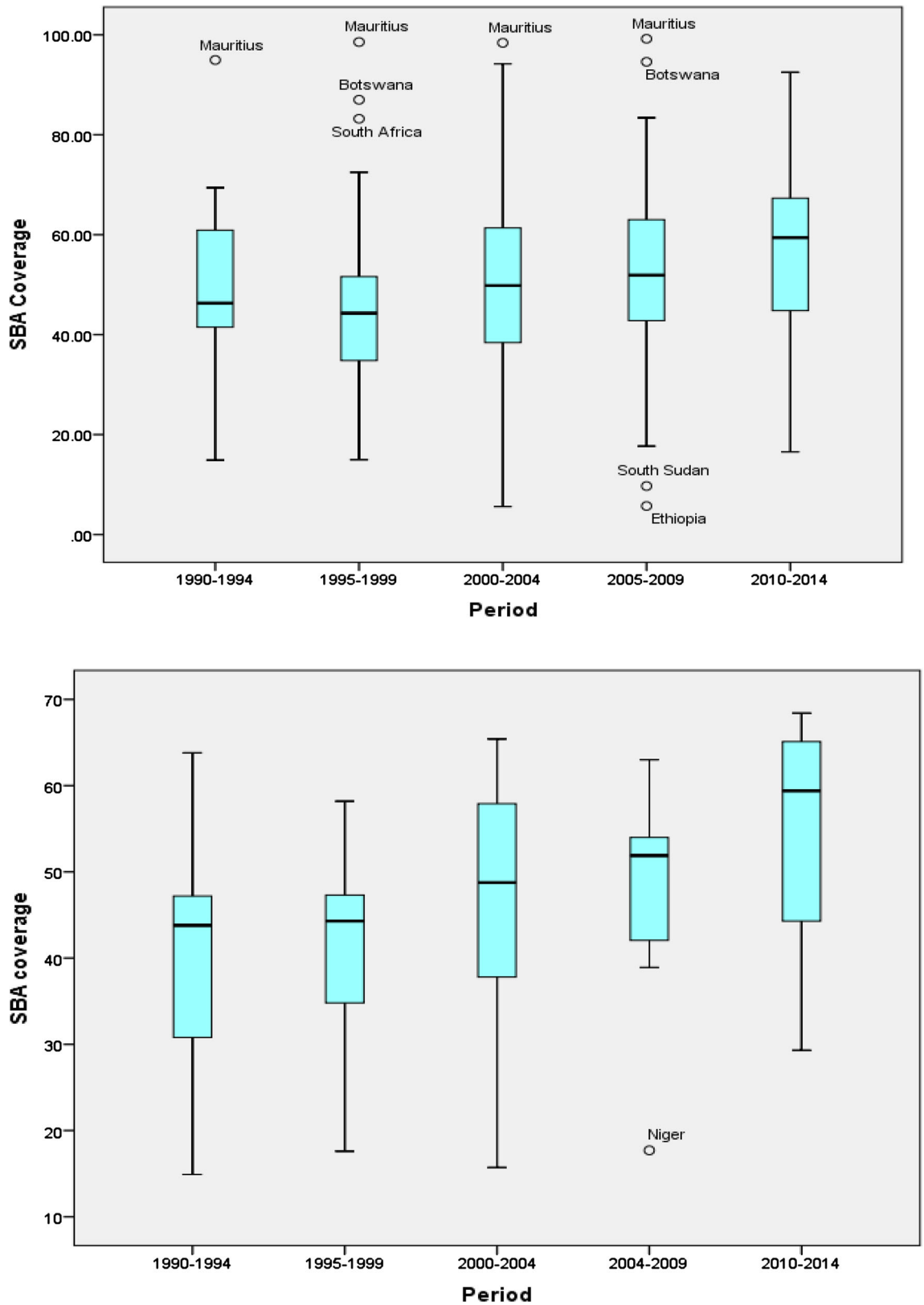

Fig. 1 Skilled birth attendance coverage of sub-Saharan Africa region considering any country with data at each specific period (**a**) and countries with data at all periods (**b**), 1990–2014. *SBA* skilled birth attendance

As shown in Table 1, ANC rate difference ranged from 76% points in 1995–1999 to 59% points in 2010–2014, whereas the coefficient of variation was dropped by 27 during the study period.

Table 2 shows the top and least performing countries in ANC and SBA coverage in each period. During the first period (1990–1994), Kenya had the highest ANC coverage (94.9%) while Niger achieved the lowest (30.1%). During the consecutive periods 1995–1999, 2000–2004, 2005–2009 and 2010–2014, Cape Verde (99.3%), Cote d'Ivoire (96.8%), Gambia (97.8%) and Burundi (98.9%), respectively, were top in the rank. On the contrary, Chad (23.4%), Ethiopia (26.7%), Somalia (26.1%) and South Sudan (40.3%) had the lowest coverage during the respective periods.

Each period had significantly higher scores as compared to the previous period. For instance, the comparison between the latest periods, 2010–2014 and 2005–2009, indicates that among the 31 countries with data in both periods, 23 of them improved their ANC coverage (positive rank), while eight of them showed a negative rank (Wilcoxon signed-rank test; $z = -3.5$, $p = 0.001$, effect size = -0.62). There was noticeable improvement in ANC from 2005 onwards (Online Resource 2).

Considering countries with ANC and SBA data in each of the periods, there was a significant improvement in ANC across time (ANOVA using Geisser correction; $F(1.8, 14.3) = 8.28$, $p = 0.005$, partial $\eta^2 = 0.51$ and power = 0.90). A planned comparison shows that, on average, a significant improvement in ANC was achieved during 2004–2009 ($F(1, 8) = 12.72$, $p = 0.008$, partial η^2 (effect size) = 0.614, power = 0.876) and 2010–2014 ($F(1, 8) = 11.62$, $p = 0.009$, partial $\eta^2 = 0.592$, power = 0.846) as compared to the baseline.

Skilled birth attendance (SBA)

The median SBA coverage increased by 15% points during the study period. These countries with SBA data for all periods had better median coverage than all countries with data at each specific period (Online Resource 3).

After an increase in each consecutive period, rate difference and rate ratio between the best and poor performing countries decreased during 2010–2014. At each period, rate difference and rate ratio were higher for SBA than ANC. As shown in Table 2, Mauritius continued to be the best achiever in SBA during 1990–1994, 1995–1999, 2000–2004 and 2005–2009 with a coverage of 95.0, 98.6, 98.4, and 99.2%, respectively; Republic of Congo (92.5%) had the highest performance in 2010–2014. Countries with the lowest rank include Niger (14.9%) during 1990–1994, Chad (15%) during 1995–1999, and Ethiopia during 2000–2004, 2005–2009 and 2010–2014 with coverage of 5.6, 5.7, and 16.5%, respectively. The findings also suggest that countries with the highest baseline SBA coverage kept achieving highest score while those with the lowest baseline continued to perform poorly throughout the periods. Country-specific coverage is displayed in Online Resource 1.

A pairwise comparison using Wilcoxon signed-rank test, as displayed in Online Resource 2, shows a significant improvement in SBA coverage during the last three periods. Between 2000–2004 and 1995–1999, 73% of countries improved their coverage (partial $\eta^2 = 0.53$, $z = -2.72$, $p = 0.007$) then progressed to 80% between 2010–2014 and 2005–2009 ($z = -4.34$, $p < 0.001$, effect size = 0.78.).

Group disparity by geographic group, economic class and cluster

Geographic group/sub-regional disparity

Eastern and western sub-regions, each constitute 35% of the SSA countries whereas only 11% of SSA countries are in southern sub-region. As shown in Table 3, eastern and western sub-regions had the lowest median SBA coverage, whereas southern sub-region continued with the highest median trend values in both indicators.

Table 1 Disparity measures of antenatal care coverage in sub-Saharan Africa countries across the five periods during 1990–2014

Periods	Number of countries (%)		ANC				SBA			
	ANC%	SBA	RD (%)	IQR	CV (%)	RR	RD (%)	IQR	CV (%)	RR
1. 1990–1994	18 (38.3)	22 (47)	65	32	43	3.2	80.1	21	35	6.4
2. 1995–1999	26 (55.3)	29 (62)	76	30	42	4.2	84	21.1	44	6.6
3. 2000–2004	39 (83.0)	40 (85)	70	25	33	3.6	93	21.3	42	17.6
4. 2005–2009	41 (87.2)	41 (87)	72	15	19	2.4	94	21.3	38	17.4
5. 2010–2014	35 (74.5)	35 (75)	59	12	16	1.4	76	24.1	34	5.6

ANC antenatal care, *SBA* skilled birth attendance, *RD* rate difference, *RR* rate ratio, *IQR* interquartile range, *CV* coefficient of variation

Table 2 Sub-Saharan Africa countries with the highest and lowest antenatal care and skilled birth attendance coverage during 1990–2014

Period	The first five countries with highest ANC and SBA coverage				The last five countries with lowest ANC and SBA coverage			
	Country	ANC %	Country	SBA %	Country	ANC %	Country	SBA %
1990–1994	Kenya	94.9	Mauritius	95.0	Niger	30.1	Niger	14.9
	Rwanda	94.4	Sudan	69.4	Mauritania	48.0	Rwanda	25.8
	Zimbabwe	93.1	Zimbabwe	69.2	Nigeria	56.5	Guinea	30.5
	Zambia	92.4	Namibia	68.2	Guinea	57.6	Nigeria	30.8
	Lesotho	90.6	Cameroon	63.8	Burkina Faso	58.6	Mauritania	40.0
1995–1999	Cape Verde	99.3	Mauritius	98.6	Chad	23.4	Chad	15.0
	Kenya	91.9	Botswana	87.0	Somalia	32.3	Niger	17.6
	South Africa	91.6	South Africa	83.2	Niger	39.3	Eritrea	20.6
	Uganda	91.2	Zimbabwe	72.5	Mali	46.9	Angola	22.5
	Zimbabwe	90.6	Cape Verde	71.3	Eritrea	48.9	Guinea-Bissau	25.0
2000–2004	Cote d'Ivoire	96.8	Mauritius	98.4	Ethiopia	26.7	Ethiop	5.6
	Gabon	94.4	Botswana	94.2	Chad	40.3	Chad	15.4
	Zambia	93.4	South Africa	91.2	Niger	41.0	Niger	15.7
	Malawi	92.6	Gabon	85.5	Mali	56.8	Somalia	24.8
	Uganda	92.4	S. T and Principe	77.5	Nigeria	58.0	Burundi	25.2
2005–2009	Gambia	97.8	Mauritius	99.2	Somalia	26.1	Ethiopia	5.7
	Cape Verde	97.6	Botswana	94.6	South Sudan	26.2	South Sudan	9.7
	Sao T. and Principe	97.6	Congo, Rep.	83.4	Ethiopia	27.6	Niger	17.7
	South Africa	97.1	Namibia	81.4	Niger	46.1	Sudan	28.8
	Rwanda	95.1	S. T. and Principe	81.2	Nigeria	57.7	Somalia	33.0
2010–2014	Burundi	98.9	Congo, Rep.	92.5	South Sudan	40.3	Ethiopia	16.6
	Gambia	98.1	Gabon	89.3	Ethiopia	42.5	South Sudan	19.4
	Rwanda	98.0	Comoros	82.2	Chad	53.2	Chad	22.7
	Swaziland	96.8	Swaziland	82.0	Nigeria	63.4	Sudan	23.1
	Ghana	96.4	Benin	80.9	C. African R.	68.2	Niger	29.3

Period refers to the 5-year time interval

ANC antenatal care coverage, *SBA* skilled birth attendance coverage

Table 3 Median (interquartile range) antenatal care and skilled birth attendance coverage by geographic group in sub-Saharan Africa

Year group	Eastern Africa		Central Africa		Southern Africa		Western Africa	
	ANC	SBA	ANC	SBA	ANC	SBA	ANC	SBA
1990–1994	92.4 (16.2)	52.6 (21.9)	78.8[b]	66.6[a]	88.9[a]	60.9 (12.2)	58.1 (30.5)	41.5 (14.1)
1995–1999	80.7 (41.7)	44.3 (14.6)	66.9[a]	34.2 (38.3)	89.6[a]	85.1[a]	77.8 (23.6)	43.0 (17.8)
2000–2004	80.1 (17.8)	41.6 (26.3)	66.9 (27.3)	60.7 (33.4)	90.6 (6.5)	75.5 (27.9)	78.9 (22.3)	50.9 (19.1)
2005–2009	91.5 (40.6)	43.9 (20.6)	82.0 (11.7)	63.0 (33.9)	94.1 (7.6)	76.5 (27.3)	84.1 (11.0)	52.7 (16.4)
2010–2014	90.2 (10.8)	55.3 (31.7)	84.7 (24.4)	63.6 (66.2)	96.8[c]	82.0[c]	90.6 (12.3)	59.4 (19.8)

ANC antenatal care, *SBA* skilled birth attendance

[a]Data for only two countries, therefore, there is no interquartile range

[b]In 1990–1994 in central Africa shows only Cameroon's ANC coverage in 1991

[c]In 2010–2014 refers to Swaziland's ANC and SBA coverage in 2010

The disparity between the eastern (the reference sub-region) and southern sub-region was higher for SBA than ANC coverage. Being the highest in 2000–2004, the

relative disparity—rate ratio in both indicators declined in the latest periods (Fig. 2).

The comparison in the distribution of SBA among the sub-regions using the Kruskal–Wallis H test shows significant difference during 1990–1994 ($\chi^2(3) = 11.3$, $p = 0.010$), 2000–2004 ($\chi^2(3) = 10.8$, $p = 0.013$) and 2005–2009 ($\chi^2(3) = 9.8$, $p = 0.020$). However, a pairwise comparison using adjusted (to the number of pairs compared) p value shows significant difference between the eastern and southern sub-regions only during 2000–2004 and 2005–2005.

Economic class disparity

Majority (70%) of the countries in the region were classified as lower income (Online Resource 1). The disparity between middle- and lower-income countries was higher for SBA than ANC coverage. Countries with a larger

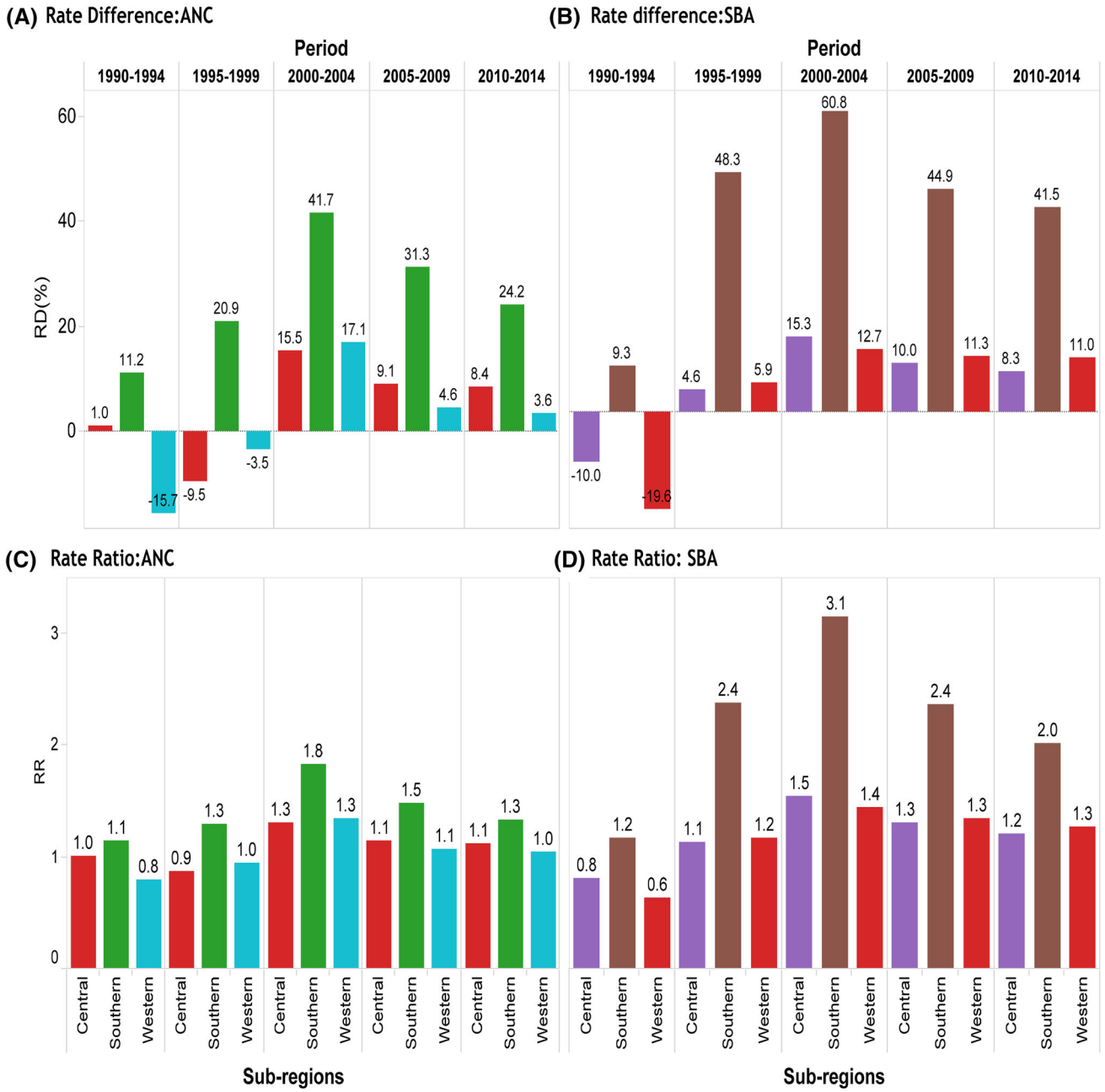

Fig. 2 Rate difference and rate ratio in antenatal care coverage and skilled birth attendance of the three sub-regions compared to eastern. *RD* rate difference, *RR* rate ratio, central refers to central Africa sub-region, southern refers to southern Africa sub-region, western refers to western Africa sub-region, eastern refers to eastern Africa sub-region. The *X*-axis on the top (period) and bottom (sub-regions) are common for all disparity measures indicated in **a**–**d**

population size tended to have lower SBA coverage. The Spearman's rank-order correlation indicated a negative relationship between population and SBA coverage particularly in the last three periods, 2000–2004 ($r = -0.33$, $p = 0.036$), 2005–2009 ($r = -0.42$, $p = 0.006$) and 2010–2014 ($r = -0.35$, $p = 0.041$).

Cluster disparity

Based on the agglomeration schedule and dendrogram, the number of clusters of countries for ANC coverage decreased from 6 to 5 in the study period, whereas for that of SBA, the number increased from 6 to 7. With an irregular disparity pattern in both indicators, higher absolute disparity was observed in ANC coverage, while relative disparity measures (as a percentage of the reference point) was higher for SBA since SBA had a lower reference point values at all periods. Online Resource 4 presents the absolute and relative disparity levels between ANC and SBA by cluster. ANC and SBA coverage, and cluster number of countries per indicator per period is indicated in Online Resource 5.

There is a difference in the patterns of absolute disparity measures, the rate difference and between group variance, in each indicator. This is due to the fact that between-group variance is weighted and affected by population size of each group. ANC and SBA also followed different pattern for the same disparity measure. Detail description is shown in Online Resource 4.

The mean difference among clusters in both indicators appeared to be significant at all periods ($p < 0.001$, power = 1, partial $\eta^2 = 0.9$). In post hoc comparison using Bonferroni correction, the highest mean difference (MD) among pairs of clusters increased from 62 (MD = 62, SEM = 2.4, $p < 0.001$) in 1990–1994 to 64 (SEM = 3.7, $p < 0.001$) in 2010–2014. As detailed in Online Resource 4(ii), the MD in SBA remained high throughout the study period despite an overall decrease by 10%.

Disparity in service continuity (ANC-SBA)

Table 4 shows the disparity between ANC and SBA in low- and middle-income countries. Despite the improvement in both ANC and SBA across time, the weighted mean and median disparities between them have been changed slowly. The overall weighted rate difference decreased by 9.5% points and the median rate difference decreased by 5.5% points in the study period with some irregularities in pattern. The median percentage difference in SBA between middle and lower income classes as a percentage of lower income has increased by 21% points (Table 4). This is because the rate difference between period 1 and 5 in the middle-income class was narrowed by 18.8% points while there was only a decrease in 7.3% points in the lower-income class.

Countries with the highest disparity include Rwanda (1990–1994 and 2000–2004), Uganda (1995–1999 and 2005–2009) and Eritrea (2010–2014). Mauritania, Somalia, South Africa, Democratic Republic of Congo and Congo Brazzaville had the lowest rate difference in each respective period. In 1990–1994, the weighted rate difference between ANC and SBA for the five best ANC performing countries was 29% points higher than for the five least performing ones; this decreased by half in 2010–2014. Among the countries with data for all periods (highlighted in bold in Online Resource 5), Ghana and Cameroon had the highest and lowest rate difference, respectively, in most periods. During 2010–2014, Niger's date difference was highest because Niger's ANC coverage improved remarkably but not the SBA coverage.

Discussion

This paper has examined maternal health care disparities, particularly ANC, SBA and the difference between them in sub-Saharan Africa over the past 25 years. The disparity focused on absolute and relative measures of the overall region. It also detailed disparities by geographic group, economic class and cluster of countries.

Progress and disparity of antenatal and skilled birth attendance coverage

Although most countries had high baseline ANC coverage, few countries like Niger who increased from 30.1% in 1992 to 82.8% in 2012, improved remarkably. The achievement in ANC could partly be due to the WHO's task-shifting strategy to less specialized health workers (Lewin et al. 2012) that has been implemented in the region (Deller et al. 2015; Mabey et al. 2013). It may also be due to the fact that at least one ANC visit is considered. The increasing ANC trend reduced the overall regional and group disparity levels especially in the most recent period, 2010–2014. Other studies also revealed such improvement (Alkenbrack et al. 2015).

SBA coverage has been low throughout the study period despite a median increase of 15% points overall. This change is almost twice that in ANC coverage, but the absolute level remained low since SBA had very low coverage at baseline. Its disparity also continued to be high as most countries that were at the bottom of the rank remained low across time. Specifically, countries like Ethiopia and Chad have low socioeconomic development along with relatively high fertility rate and low contraceptive prevalence rates. Hence, the consistently low

Table 4 Disparity in antenatal care and skilled birth attendance between middle-income- (MI) and lower-income (LI) countries

Period	Median RD (ANC-SBA) (%)	Weighted RD (ANC-SBA) (%)	ANC disparity (%)			SBA disparity (%)		
			ANC (MI)	ANC (LI)	PD	SBA (MI)	SBA (LI)	PD
1990–1994	32.1	42.8	78.4	84.3	− 7.0	46.3	50.1	− 7.6
1995–1999	37.2	43.4	84.3	76.8	9.8	47.1	42.1	11.9
2000–2004	27.4	37.0	89.1	78.9	12.9	61.7	46.2	33.5
2005–2009	25.7	38.9	87.4	84.5	3.4	61.7	46.2	33.5
2010–2014	26.6	33.3	91.6	88.6	3.4	65.1	57.4	13.4

RD rate difference, *ANC* antenatal care, *SBA* skilled birth attendance, *MI* middle income, *LI* lower income, *PD* percentage difference, calculated using median values, (MI − LI)/LI × 100%

coverage could be attributed to political economy, fertility and access to health services. We also noted that not all countries had shown improvement in SBA coverage, which means, the overall regional increase is due to the success of some countries. Other studies have described SBA as the most inequitable maternal health service within and among countries (Barros et al. 2012; United Nations 2006, 2015a). The other issue with SBA coverage is its negative linear relationship with a country's population size. In 2010–2014, countries with regional population share of only 11% achieved 70% and above. On the other hand, countries which accounted for 49% of the regional population share had less than 50% coverage. In the UN MDG reports, the SSA region has been described as having the lowest SBA coverage next to South Asia (United Nations 2014). This is an implication that the regional SBA coverage may not be improved easily with the current routine resources and efforts. In addition, similar pattern in the number of clusters and the irregular disparity patterns also indicate a persistent inequality among countries.

Disparity between ANC and SBA coverage

This study indicates high disparity between ANC and SBA coverage although there has been a decrease in the most recent period. While only two countries had less than 50% ANC coverage during 1990–1994, more than half of the countries had less than 50% coverage in SBA. During 2010–2014, 86% of the countries had ANC coverage of 70% and above, but similar coverage in SBA was attained by only 20%. The study reveals a significant correlation between ANC and SBA coverage (period = 2010–2014, $r = 0.69$, $p < 0.001$). However, countries with the best ANC coverage had a higher disparity between ANC and SBA coverage than those with the least ANC coverage. This highlights the possibility of ceiling effect with SBA.

ANC coverage (at least one visit) was once recognized as a success story in Africa (Lincetto et al. 2006). However, in a region where maternal mortality is still high (United Nations 2015a), it is not a success unless followed by utilization of SBA service. As noted by the WHO and UN report, ANC service alone is not a guarantee of maternal health; it is rather an entry point whereby SBA can be promoted (United Nations 2014; World Health Organization 1997). This is because many elements of ANC do not have any impact in reducing the risk of serious complications and maternal deaths (Maine 1991; Villar and Bergsjo 2002). On the other hand, SBA service has an important role in reducing risks and saving the lives of mothers. It is also fundamental to reaching the SDGs particularly goal four and ten, focuses attaining healthy life for all at all ages and reducing inequalities, respectively (Zachary et al. 2013; Pearson et al.; United Nations 2015b). Therefore, all women should receive SBA service as a universal access since the interventions known to save the lives of women depend on it.

The 2010–2014 data show a 33% regional rate difference between ANC and SBA coverage. If we assume that those who received SBA service also received ANC, one-third of ANC attendants did not get SBA service. Despite multiple reports about the efforts to allow women wider access to the health system and skilled health workers, studies show that health facility-related, provider-related, client-related and other physical factors play important roles for low SBA coverage (Amoakoh-Coleman et al. 2015; Prata et al. 2011; Sharan et al. 2010). The region has much more to do to tackle factors for low utilization and high disparity.

The inter-country disparity shows that some countries were still at the bottom of the rank, while some improved significantly at the end of the study period. Despite the existence of a considerable progress in ANC and SBA coverage, the current evidence suggests key bottlenecks in quality of the services. Evidence about disparities among countries could inform regional policies and programming. On the other hand, the within-country disparity between ANC and SBA has implication on the continuity and quality of maternal health services. Hence, this evidence

would be useful in programming approaches that can fill the gap. This calls for concerted efforts by governmental and non-governmental organization not only to increase ANC and SBA coverage, but also to ensure equitable coverage within countries.

There are some limitations associated with this study. First, not all countries had complete data for all years. Thus, we used an average of 5-year interval period data. Second, the dispersion across countries was so wide that non-parametric statistics were mostly used. Third, country level aggregated ANC and SBA coverage data obscured disparities within countries. The latter is not covered in his paper.

Conclusions and recommendations

With an overall better baseline ANC coverage, the SSA region showed improvements in both ANC and SBA coverage across time. SBA coverage in the region is still very low as it is negatively correlated with countries' population size. Disparities in ANC coverage narrowed while that in SBA coverage started to decline during the most recent time period after successive increases. The absolute and relative disparity between middle-income and lower-income countries was higher for SBA than ANC coverage. Disparities in both ANC and SBA coverages were associated with economic class and cluster of countries. It is also noted that countries with high ANC coverage have higher disparity between ANC and SBA coverage. SBA remained low in most counties. In line with the above findings, country-specific interventions need to be taken by policy makers and international agencies to address the barriers and hence to ensure sustainable improvement. Further, sub-national level study is needed to explore factors contributing to these disparities.

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Compliance with ethical standards

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

Conflict of interest MAW declares that she has no conflict of interest. JB declares that he has no conflict of interest. JH declares that she has no conflict of interest. WB declares that he has no conflict of interest.

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