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Individual-level and community-level factors associated with eight or more antenatal care contacts in sub-Saharan Africa: evidence from 36 sub-Saharan African countries

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ABSTRACT

Objective To reduce maternal mortality, the WHO has been introducing several antenatal care (ANC) measures. Pregnancy-related preventable morbidity and mortality, on the other hand, remain alarmingly high. This study was conducted to estimate the magnitude and the factors associated with eight or more ANC visits in sub-Saharan Africa.

Design A population-based, cross-sectional investigation was conducted.

Setting Sub-Saharan African countries.

Participants A total of 300 575 women from recent Demographic and Health Surveys (DHS) conducted in 36 sub-Saharan African countries from 2006 to 2018 were included in this study.

Methods The data were sourced from sub-Saharan African countries' recent DHS data set from 2006 to 2018. A multilevel logistic regression model was fitted to identify factors associated with ANC use. Adjusted OR, with 95% CI and a p value of less than 0.05, was employed to determine parameters linked to ANC use.

Results The pooled magnitude of eight or more ANC visits in sub-Saharan African countries was 6.8% (95% CI 6.7% to 6.9%). Residence, maternal education, husband's education, maternal occupation, wealth index, media exposure, contraceptive use and desired pregnancy were all positively associated with eight or more ANC visits in the multilevel logistic regression analysis, whereas birth order was negatively associated with eight or more ANC visits.

Conclusions Compliance with the WHO guidelines on the minimum number of ANC contacts in sub-Saharan Africa is poor. We recommend that mother and child health programmes review existing policies and develop new policies to adopt, execute and address the obstacles to maintaining the WHO-recommended minimum of eight ANC interactions. Women's education, economic position, media exposure and family planning uptake should be prioritised and improved. Urgent intervention is required to meet the minimum of eight ANC contacts in sub-Saharan Africa.

Strengths and limitations of this study

- The study is on a maternal health issue, which is a low and less researched area.
- The study was conducted in 36 sub-Saharan African countries and therefore generalisation of the results is possible.
- The study was based on cross-sectional data, which implies that the direction of causal relationship cannot always be determined.

BACKGROUND

In 2001, the WHO advised that low-income and middle-income nations employ focused antenatal care (FANC) instead of the traditional antenatal care (ANC) strategy (defined by 7–16 visits). Travel times to and from clinics, waiting time, transportation cost where clinics are located far away, loss of working hours and care of other children at home were all expected to be addressed by the FANC.[1 2] A major challenge in the world, including in sub-Saharan Africa (SSA), is the difficulty of improving maternal and child health condition.[3] SSA accounted for 66% of global maternal deaths according to a WHO report in 2017.[4 5] A previous study also supported this finding, with maternal mortality in low-income and middle-income countries 14 times higher than in high-income countries in 2014.[6]

Pregnancy-induced avoidable morbidity and mortality remained excessively high at introducing the Sustainable Development Goals (SDGs) in 2016." by "Pregnancy-induced avoidable morbidity and mortality remained excessively high by the time the Sustainable Development Goals (SDGs) introduced in 2016. Although significant progress has been accomplished, countries need to integrate and enhance these advances and extend their priorities beyond survival to boost the health and productivity

of their citizens.[1] Thus, in 2016, the WHO further revised its recommended minimum number of ANC visits from four to eight contacts.[7] The guidelines include a new approval that pregnant women should have eight contacts with the health system during their pregnancy.[2 8] The first contact should be made up to 12 weeks after conception and the eighth contact up to 40 weeks after conception.[2 8]

By providing good maternal healthcare, most maternal and pregnancy-related deaths can be managed through early detection of complications. ANC is among the maternal and child health service packages designed to reduce preventable maternal and childhood mortalities is ANC.[3] According to the WHO 2016 recommendation, a pregnant woman is considered to have used ANC when she has made eight contacts and above with a skilled healthcare provider during her pregnancy.[7] ANC can reduce maternal morbidity and mortality through diagnosis and management of pregnancy-related illness.[9] ANC takes the lion's share, along with other maternal health services.[7] Nonetheless, it is unusual to see pregnant women who deny ANC service.[10]

However, as per the new recommendation of the WHO on the number of ANC contacts, an analysis of Demographic and Health Survey (DHS) data showed only 17.4% of pregnant women in Nigeria made eight contacts and above with skilled healthcare providers,[11] whereas a previous study showed that nearly 80% and 40% of pregnant mothers in SSA attended at least one and four ANC visits, respectively, in 2016.[6] A disappointing approach during ANC counselling may disrupt continuity of care and affect the health of both children and women.[12]

Studies conducted in different countries have reported that maternal age, number of living children, educational status, place of residence, occupation, religion, socioeconomic status and obstetric history were factors significantly associated with use of ANC services.[7 13 14] Similarly, in low-income and middle-income countries, a recent study described pregnant women's level of education and their husbands' as the most considerable factor influencing health service utilisation.[15 16] All over SSA countries, however, little is known about the influence of routine ANC on early access, utilisation and quality of ANC services. This work aims to close this knowledge gap.[17]

This analysis aimed to estimate the pooled prevalence and the factors associated with ANC visits during pregnancy in SSA countries using recent DHS data. The current information is essential for policy planners and programme managers when designing strategies to improve maternal and child health. This analysis aimed to summarise the magnitude of ANC utilisation and the associated factors among pregnant women or women who had given a minimum of one birth 5 years prior to the survey in SSA.

Table 1 Pooled Demographic and Health Surveys (DHS) data from 36 sub-Saharan countries, 2006–2018

Country	DHS year	Sample size (300 575)
Southern region		11 554
Lesotho	2014	2575
Namibia	2013	3813
Swaziland	2006/2007	2130
South Africa	2016	3036
Central region		88 207
Angola	2015/2016	14 379
Democratic Republic of the Congo	2013/2014	18 827
Congo	2011/2012	10 819
Cameroon	2011	15 426
Gabon	2012	8422
Sao Tome and Principe	2008/2009	2615
Chad	2014/2015	19 917
Eastern region		98 663
Burundi	2010	8940
Ethiopia	2016	7590
Kenya	2014	14 141
Comoros	2012	2064
Madagascar	2008/2009	8661
Malawi	2015/2016	13 515
Mozambique	2011	7874
Rwanda	2014/2015	6059
Tanzania	2015/2016	7078
Uganda	2011	10 152
Zambia	2018	7324
Zimbabwe	2013/2014	4987
Western region		102 151
Burkina Faso	2010	10 487
Benin	2017	9030
Cote d'Ivoire	2011	5229
Ghana	2014	4141
Gambia	2013	5293
Guinea	2018	5487
Liberia	2013	4769
Mali	2018	6622
Nigeria	2018	21 911
Niger	2012	8002
Sierra Leone	2010/2011	8647
Senegal	2010/2011	7678
Togo	2013/2014	4851

METHODS

Data source

The most recent DHS data from 36 countries in SSA were used in this study (table 1). These statistics were combined to determine the prevalence of ANC visits in

SSA and the factors that influence them. The DHS is a national survey that collects information on basic health indicators such as mortality, morbidity, family planning service use, fertility, and mother and child health. The data came from the Measure DHS programme. Men, women, children, birth and household data sets are all included in each country's survey; in this study, an Individual Record (IR) file was employed.

The IR file contains all the information obtained for de facto women in the woman's questionnaire, as well as some variables from the household questionnaire. This file contains repeated variables for up to 20 births in the birth history and up to 6 children under the age of 5, for whom pregnancy and postnatal care, immunisation, health and nutrition data were gathered. Most women-level analyses, such as on marriage and sexual activity, fertility and fertility choices, family planning, anthropometry and anaemia in women, malaria prevention in women, HIV/AIDS, women empowerment, adult and maternal mortality, and domestic violence, are conducted using this data set.

To choose research participants, the DHS employed a two-stage stratified selection procedure. To begin, we combined data from 36 DHS conducted in SSA countries, resulting in a weighted sample of 300 575 reproductive-age women who had at least one child in the 5 years prior to the survey.

Measurement of variables

Outcome variable

The 'number of ANC visits' was the study's outcome variable. The percentage of women aged 15–49 who had a live birth at a specific time and got ANC services during pregnancy was used to calculate the number of ANC in this study. The question 'How many times did you receive antenatal treatment throughout this pregnancy?' was the source of this variable. In SSA, responses varied from 0 to 30. According to the revised WHO standards, the number of ANC visits of pregnant women should be divided into two categories: zero visit and one visit.[7 11]

Explanatory variables

We evaluated both individual-level and household-level factors/community-level factors in our analysis based on theoretical and practical significance and the availability of the variables in the data set. In addition, factors were chosen based on their degree of correlation with frequency of ANC visits from prior studies.[7 11 13 14]

Maternal current age (15–24, 25–34, 35 and above), maternal level of education (no education, primary, secondary and above), husband's level of education (no education, primary, secondary and above) and marital status (currently married, cohabitating) were the individual-level factors. Working status (working vs not working), healthcare access (major problem vs minor problem), media exposure (no vs yes), desired pregnancy (yes vs no), contraceptive use (yes vs no) and birth order (1, 2–4 and 5+) were also evaluated, along with community-level factors including living region (East, West, Central, South) and residence (urban, rural).

Data management and analysis

After extracting the variables based on the literature, we combined the data from the 36 SSA countries. To restore the representativeness of the survey and take sample design into account when generating SEs and reliable estimates, the data were weighted using sampling weight, primary sampling unit and strata before any statistical analysis. STATA V.14 was used to perform cross-tabulations and summary statistics. From 2006 to 2018, 95% CI was given for the pooled prevalence of prenatal care utilisation in SSA countries.

Statistical modelling

The DHS data have a hierarchical structure, which contradicts the classic logistic regression model's independence of observations and equal variance assumption. As a result, women are nested within a cluster based on the assumption that women in the same cluster are more similar. This means that advanced models should be used to account for between-cluster heterogeneity. A total of four models were fitted. Model 1 (community-level variables), model 2 (individual-level variables) and model 3 are examples of null models (models without explanatory variables) (both individual-level and community-level variables). Model 3 was chosen because it has the highest log-likelihood ratio and the smallest deviation and contains both individual-level and community-level variables.

Fixed and random effect estimates

The variables included in the model, both individual-level and community-level variables, were used in the fixed effect analysis. Variations between clusters (EAs) were analysed using intraclass correlation coefficient (ICC), proportional change in variance (PCV) and median OR (MOR) in the random effect analysis.[18] ICC is the proportion of variance explained by the population's group structure. It was calculated as follows: $\mathrm{ICC}=\frac{\sigma_\mu^2}{\sigma_\mu^2+\frac{\pi^2}{3^3}}$, where the variance of the standard logit distribution is $\frac{\pi^2}{3}$ and σ_μ^2 indicates cluster variance.

PCV measures the total variation attributed by individual-level and community-level factors in the multilevel model as compared with the null model. It was computed as follows: $\frac{\text{variance of null model}-\text{variance of full model}}{\text{variance of null model}}$. When randomly selecting two clusters, MOR is defined as the median value of the OR between the cluster at high risk and the cluster at lower risk of recommended ANC usage (EAs). It was calculated as follows: $\mathrm{MOR}=\exp\left(\sqrt{2*\sigma_\mu^2*0.6745}\right)\sim\mathrm{MOR}=\exp\left(0.95*\sigma_\mu\right)$.

Patient and public involvement

This study did not include any patient.

Table 2 Distribution of postnatal service utilisation in sub-Saharan Africa region

Variable	ANC utilisation		Total (%)	χ^2 value	P value
	Yes	No			
African region					
Southern	10 044	1509	11 553 (3.84)	54.23	<0.001*
Central	79 304	8902	88 207 (29.35)		
Eastern	91 782	6880	98 663 (32.82)		
Western	88 165	13 986	102 151 (33.99)		
Residence					
Rural	165 566	25 463	191 029 (63.55)	82.35	<0.001*
Urban	103 730	5815	109 546 (36.45)		
Age group					
15–24	91 025	8708	99 733 (33.18)	361.45	<0.001*
25–34	111 984	13 824	125 808 (41.86)		
35–49	66 287	8746	75 033 (24.96)		
Maternal education					
No education	84 928	20 746	105 657 (36.16)	81.89	<0.001*
Primary education	92 800	6620	99 420 (33.08)		
Secondary and above	91 567	3912	95 480 (31.77)		
Husband education					
No education	72 138	17 711	89 849 (36.18)	196.83	<0.001*
Primary education	61 978	5504	67 482 (27.55)		
Secondary and above	82 953	5015	87 608 (35.77)		
Maternal occupation					
Had occupation	192 557	21 407	86 610 (28.82)	286.55	<0.001*
Had no occupation	76 739	9871	213 964 (71.18)		
Wealth index					
Poor	102 762	19 080	121 842 (40.54)	120.51	<0.001*
Middle	53 829	5654	59 483 (19.79)		
Rich	112 705	6544	119 249 (39.67)		
Media exposed					
Yes	189 649	13 366	97 537 (32.45)	54.59	<0.001*
No	79 630	17 906	203 016 (67.55)		
Accessing healthcare					
Big problem	112 299	11 293	175 471 (58.67)	458.11	<0.001*
Not a big problem	155 618	19 852	123 592 (41.33)		
Wanted pregnancy					
Yes	207 875	28 706	17 448 (6.87)	1.56	0.211
No	15 259	2188	236 582 (93.13)		
Contraceptive use					
Yes	79 345	4210	83 555 (28.51)	84.39	<0.001*
No	182 744	26 730	209 474 (71.49)		
Birth order					
1	53 639	4608	582 547 (19.38)	537.22	<0.001*
2–4	117 344	13 447	130 792 (43.51)		
5+	98 312	13 223	111 535 (37.11)		

*Significant association between ANC visit and independent variables.
ANC, antenatal care.

Table 3 Pooled prevalence of eight or more ANC contacts in sub-Saharan Africa

ANC contacts 2006–2018	% (95% CI)
<8 visits	93.2 (93.1 to 93.3)
≥8 visits	6.8 (6.7 to 6.9)

ANC, antenatal care.

RESULTS

This study comprised 300 575 women from 36 SSA countries who had at least one child 5 years before the survey. Majority of the study participants (102 151, 33.99%) were from Western Africa, while the least number of study participants (11 553, 3.84%) came from Africa's southern regions. Majority of the participants (191 029, 63.55%) were from rural areas. The median age of women in this study was 28.8 (IQR=7.2) years, with 125 808 (41.86%) between the ages of 25 and 34. Thirty-three per cent of women and 36 per cent of men lacked high school diploma. More than a third of women (121 842, 40.54%) lived in poverty (table 2).

Prevalence of eight or more ANC contacts

In SSA, the pooled prevalence of ANC use was 6.8% (95% CI 6.7 to 6.9) (table 3).

Determinants of ANC utilisation

Multilevel multivariable logistic regression was used to fit the model for this study. The random effects estimates and the fixed estimates are the two types of estimations in this model. Fitting four models revealed the fixed and random effects estimates (null model, model 1, model 2, model 3). Within SSA, the empty model revealed a substantial variance in the likelihood of ANC use (model 2=0.46, p=0.001). The ICC in the empty model implied that the difference across countries was responsible for 12.49% of the entire variation in ANC use. ICC and MOR were used to express cluster-level variance.

Furthermore, the MOR was 1.91 (95% CI 1.84 to 1.99), meaning that when women moved from countries with low to high ANC usage, their chances of receiving ANC were 1.91 times higher. Cluster-level variance (model 2=0.65, p=0.001) remained significant in model 3 (complete model corrected for individual-level and community-level covariates). Country-level factors were responsible for 39.87% of the variation in ANC usage. The PCV in this model was 39.87%, indicating that both country-level and individual-level variables explained 39.87% of the national variation seen in the empty model (table 4).

Residence and media exposure were statistically significant community-level factors in the multilevel multivariable logistic regression model in the SSA region. Individual-level statistically relevant predictors were maternal education, husband education, maternal occupation, wealth index, contraception use, birth order and desired pregnancy.

When compared with rural women, the likelihood of urban women receiving ANC increased by 32% (adjusted OR (AOR)=1.32, 95% CI 1.27 to 1.37). When compared with women with no formal education, the odds of receiving ANC were 2.19 (AOR=2.19, 95% CI 2.11 to 2.28) and 2.46 (AOR=2.46, 95% CI 2.33 to 2.60) times higher for women with primary and secondary education. When compared with women whose husbands had no formal education, the odds of ANC use were 1.75 (AOR=1.75, 95% CI 1.66 to 1.80) and 1.71 (AOR=1.71, 95% CI 1.64 to 1.79) times higher for women whose husbands had primary and secondary and above education. Women with occupation were 1.26 (AOR=1.71, 95% CI 1.64 to 1.79) times more likely to use ANC than women without occupation. Women of middle and rich wealth status were 1.32 (AOR=1.32, 95% CI 1.28 to 1.37) and 1.38 (AOR=1.38, 95% CI 1.32 to 1.43) times more likely than poor women to use ANC. Those who were exposed to media were 1.97 times more likely to use ANC than women who were not (AOR=1.97, 95% CI 1.91 to 2.03). Women who said obtaining healthcare was not a large difficulty were 1.08 times more likely to use ANC than women who said accessing healthcare was a big problem (AOR=1.08, 95% CI 1.05 to 1.11). When compared with women with the first birth order, the odds of receiving ANC were 15% (AOR=0.85, 95% CI 0.81 to 0.76) and 24% (AOR=0.24, 95% CI 0.72 to 0.81) lower for women with birth orders 2–4 and 5+. Women who desired conception were 1.22 times more likely to use ANC than their counterparts (AOR=1.22, 95% CI 1.15 to 1.30). Contraceptive users were 1.89 times more likely to use ANC (AOR=1.22, 95% CI 1.15 to 1.30) (table 4).

DISCUSSION

This study carried out an assessment of the magnitude and the factors that influence use of ANC among women of SSA, showing that the pooled magnitude of ANC utilisation in SSA countries was 6.8%. This finding is lower than a meta-analysis reported elsewhere (63.77%),[6] the 2016 Ethiopian DHS (62.8%),[19] a study conducted in Ethiopia (94.9%)[20] and an analysis of Ugandan DHS data from 2007 to 2011. The possible explanation for this may be due to the wider geographical coverage of this study compared with all other studies.

In this analysis, we identified a range of determinants of ANC use in SSA. The current analysis identified that socioeconomic and reproductive status as well as knowledge on the value of ANC service are important factors that influence ANC use in SSA.

In this analysis, urban residence and media exposure were the community-level variables positively correlated with ANC utilisation. Similarly, women's and their husbands' advanced level of education, contraceptive use among women, occupation among women, improved economic status among women and wanted pregnancy were the individual-level variables positively correlated with ANC utilisation, whereas birth order was the

Table 4 Results of the multilevel logistic regression analysis of ANC visits in sub-Saharan Africa

Variable	Null model AOR (95% CI)	Model 1 AOR (95% CI)	Model 2 AOR (95% CI)	Model 3 AOR (95% CI)
Residence				
Rural		1		1
Urban		2.18 (2.70 to 2.87)		1.32 (1.27 to 1.37)*
Age group				
15–24			1	1
25–34			1.14 (1.09 to 1.18)	1.09 (0.98 to 1.13)
35–46			1.16 (1.10 to 1.22)	1.07 (0.97 to 1.11)
Maternal education				
No education			1	1
Primary education			2.02 (1.95 to 2.10)	2.19 (2.11 to 2.28)*
Secondary and above			2.11 (2.00 to 2.22)	2.46 (2.33 to 2.60)*
Husband education				
No education			1	1
Primary education			1.72 (1.66 to 1.79)	1.73 (1.66 to 1.80)*
Secondary and above			1.48 (1.42 to 1.54)	1.71 (1.64 to 1.79)*
Maternal occupation				
Had no occupation			1	1
Had occupation			1.36 (1.32 to 1.40)	1.26 (1.23 to 1.30)*
Wealth index				
Poor			1	1
Middle			1.35 (1.30 to 1.40)	1.32 (1.28 to 1.37)*
Rich			1.55 (1.50 to 1.61)	1.38 (1.32 to 1.43)*
Media exposed				
No			1	1
Yes			2.26 (2.20 to 2.32)	1.97 (1.91 to 2.03)*
Accessing healthcare				
Big problem			1	1
Not a big problem			1.00 (0.98 to 1.03)	1.08 (1.05 to 1.11)*
Wanted pregnancy				
No			1	1
Yes			1.24 (1.14 to 1.28)	1.22 (1.15 to 1.30)*
Contraceptive use				
No			1	1
Yes			2.14 (2.05 to 2.23)	1.89 (1.81 to 1.97)*
Birth order				
1			1	1
2–4			0.80 (0.76 to 0.84)	0.85 (0.81 to 0.89)*
5+			0.67 (0.64 to 0.71)	0.76 (0.72 to 0.81)*
Variance	0.469 (0.416 to 0.529)	0.47 (0.417 to 0.527)	0.487 (0.426 to 0.555)	0.656 (0.581 to 0.740)
ICC	12.49 (11.22 to 13.87)	12.48 (11.25 to 13.81)	12.89 (11.48 to 14.45)	16.63 (15.02 to 18.37)
PCV, %	1	0.106	–3.85	–39.87
MOR	1.91 (1.84 to 1.99)	1.91 (1.84 to 1.99)	1.94 (1.85 to 2.02)	2.15 (2.06 to 2.26)
LL	–101 995	–97 879	–75 286	–73 353
Deviance	203 990	195 758	150 572	146 706
AIC	203 994	195 771	150 607	146 749
BIC	204 016	195 834	150 782	146 966

Continued

Table 4 Continued

Variable	Null model AOR (95% CI)	Model 1 AOR (95% CI)	Model 2 AOR (95% CI)	Model 3 AOR (95% CI)

AIC, Akaike's Information Criteria
BIC, Bayesian Information Criteria
LL, Log likelyhood
*Significant at p≤0.05.
ANC, antenatal care; AOR, adjusted OR; ICC, intraclass correlation coefficient; MOR, median OR; PCV, proportional change in variance.

individual-level variable negatively associated with ANC utilisation in the study area.

The likelihood of ANC use among urban women increased by 32% compared with their counterparts, a finding supported by studies elsewhere.[6 21 22] It could be justified by the lack of access to health facilities, and awareness is much easier for urban dwellers. The likelihood of ANC use among women who attended primary and secondary and above education was 2.19 and 2.46 times higher compared with women with no formal education, respectively, a result supported by findings elsewhere.[15 23] This can be driven by the fact that educated women tend to be more aware of the significance of ANC services. Education increases women's autonomy, decision-making power within the household, and trust and ability to decide about their safety.[24–26] Likewise, women whose husbands had primary and secondary and above education were 1.73 and 1.71 times more likely to use ANC than women whose husbands had no formal education, a finding consistent with other studies.[6 22] The authors clarified that this could be because more educated husbands are more conscious of the value of ANC.[27] Women with occupation were 1.26-fold more likely to use ANC than their counterparts, a result similar to other findings elsewhere.[28] This might be because women with occupation may have decision-making power and are well-paid, which resolves financial barriers to ANC services. Women of middle and rich wealth status were 1.32-fold and 1.38-fold more likely to use ANC than poor women. Also, women exposed to media were 1.97-fold more likely to use ANC compared with their counterparts. This finding is supported by other studies.[15 29] This finding may be due to media access making women aware of the risks associated with missing ANC. Women who considered healthcare access as if it is not a big problem were 1.08 times more likely to use ANC compared with their counterparts, a finding that agrees with a systematic review done in developing countries.[15] This might be due to the reason that women who belived that accessibility of healthcare is not a major issue, are encouraged to have ANC. The likelihood of ANC utilisation among women whose birth order laid two to four, and five and above were declined by 15% and 24% respectively than women who had first birth order. Our finding is similar to other studies elsewhere.[15 30] This relationship might involve restricted access to resources and time constraints related to childcare and household activities.[31]

Women who wanted pregnancy were 1.22 times more likely to use ANC than their counterparts, a finding similar to two analyses done using nationally representative Bangladesh DHS.[32 33] This may be because women who have desired pregnancy may have emotional readiness that emerges from favourable actions, either from their spouses, close relatives, etc. Women who use contraceptives were 1.89 times more likely to use ANC than their counterparts, a finding supported by other studies conducted elsewhere.[34] This relationship may be due to women using contraception having the opportunity to be told about maternal health services. Besides, women who use contraceptives may have prior knowledge about women's health services.

Strengths and limitations of the study

Findings from the study are supported by large data sets covering 36 countries in SSA. The data were gathered following a common internationally acceptable methodological procedure. Due to the representative nature of the survey, the findings are representative of the included countries and generalisable to women of reproductive age in SSA. Despite these strengths, the survey is cross-sectional and as such causal inference cannot be made.

CONCLUSIONS

Compliance with the WHO guidelines on the minimum number of ANC contacts is poor in SSA. We recommend that mother and child health programmes review existing policies and develop new policies to adopt, execute and address the obstacles to maintaining the WHO-recommended minimum of eight ANC interactions. Women's education, economic position, media exposure and family planning uptake should be prioritised and improved. Urgent intervention is required to meet the minimum of eight ANC contacts in SSA.

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The research was based on a secondary analysis of existing survey data that had been stripped of any identifying information. Through an online request to http://www.measuredhsprogram.com, permission for data access was gained from Measure DHS.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data are available upon reasonable request. Data may be obtained from a third party and are not publicly available. All data relevant to the study are included in the article or uploaded as supplementary information. Data are available online and can be accessed at www.measuredhs.com.

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