Does women's empowerment and socio-economic status predict adequacy of antenatal care in sub-Saharan Africa?

Richard Gyan Aboagye[a], Joshua Okyere [b], Abdul-Aziz Seidu [c,d], Bright Opoku Ahinkorah[e], Eugene Budu[f] and Sanni Yaya [g,h,i,*]

[a]Department of Family and Community Health, Fred N. Binka School of Public Health, University of Health and Allied Sciences, Hohoe, Ghana; [b]Department of Population and Health, University of Cape Coast, Cape Coast, Ghana; [c]Faculty of Built and Natural Environment, Department of Estate Management, Takoradi Technical University, Takoradi, Ghana; [d]College of Public Health, Medical and Veterinary Sciences, James Cook University, Australia; [e]School of Public Health, Faculty of Health, University of Technology Sydney, Sydney, NSW, Australia; [f]Research Unit, Korle Bu Teaching Hospital, P.O. Box 77, Accra, Ghana; [g]University of Parakou, Faculty of Medicine, Parakou, Benin; [h]School of International Development and Global Studies, University of Ottawa, Ottawa, ON, Canada; [i]George Institute for Global Health, Imperial College London, London, UK

*Corresponding author: Tel: 613-562-5800; E-mail: sanni.yaya@gmail

Background: Quality and adequate antenatal care (ANC) are key strategies necessary to achieve Sustainable Development Goal 3.1. However, in sub-Saharan Africa (SSA), there is a paucity of evidence on the role women's empowerment and socio-economic status play in ANC attendance. This study aimed to examine whether women's empowerment and socio-economic status predict the adequacy of ANC in SSA.

Methods: Data from the recent Demographic and Health Surveys (DHSs) of 10 countries in SSA were used for the study. We included countries with a survey dataset compiled between 2018 and 2020. We included 57 265 women with complete observations on variables of interest in the study. Frequencies and percentages were used to summarize the results of the coverage of adequate ANC services across the 10 countries. A multivariable binary multilevel regression analysis was employed to examine the association between women's empowerment and socio-economic status indicators and the adequacy of ANC. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were used to present the findings of the regression analysis.

Results: The average prevalence of adequate ANC in SSA was 10.4%. This ranged from 0.2% in Rwanda to 24.5% in Liberia. Women with medium (aOR 1.24 [CI 1.10 to 1.40]) and high (aOR 1.24 [CI 1.07 to 1.43]) decision-making power had higher odds of adequate ANC compared to those with low decision-making power. Women with higher levels of education (aOR 1.63 [CI 1.36 to 1.95]) as well as partners with higher education levels (aOR 1.34 [CI 1.14 to 1.56]) had the highest odds of adequate ANC compared to those with no formal education. Additionally, those working (aOR 1.35 [95% CI 1.23 to 1.49]) and those in the richest wealth category (aOR 2.29 [CI 1.90 to 2.76]) had higher odds of adequate ANC compared to those who are not working and those in the poorest wealth category. Those with high justification of violence against women (aOR 0.84 [CI 0.73 to 0.97]) had lower odds of adequate ANC compared to those with low justification of violence against women.

Conclusions: Adequacy of ANC was low across all 10 countries we included in this study. It is evident from the study that women's empowerment and socio-economic status significantly predicted the adequacy of ANC. As such, promoting women's empowerment programs without intensive improvements in women's socio-economic status would yield ineffective results. However, when women's empowerment programs are combined with active improvements in socio-economic status, then women will be encouraged to seek adequate ANC.

Keywords: antenatal care, socio-economic status, sub-Saharan Africa, women's empowerment.

Background

Maternal mortality continues to occupy an integral aspect of global public health concerns. This is because nearly 800 women die each day of preventable adverse maternal conditions (e.g. eclampsia, haemorrhage, sepsis), with a substantial proportion (94%) of these deaths occurring in low- and middle-income countries.[1,2] Sub-Saharan Africa (SSA) suffers the greatest burden of maternal mortality despite achieving a significant milestone of a 40% reduction in maternal mortality between 1990 and 2015.[2] As such, the international community, through the ratification of the Sustainable Development Goals (SDGs), has pledged to 'reduce the global maternal mortality ratio to less than 70 per 100 000 live births' by 2030, which has been set as target 3.1.[3]

Quality and adequate antenatal care (ANC) are the key strategies necessary to make the attainment of SDG 3.1 possible. For instance, there is a preponderance of evidence that shows that a greater level of ANC is strongly associated with a lower risk of preterm births, as well as reducing maternal mortality by 20%.[4,5] As such, the adequacy of ANC is extremely important in ensuring the best maternal and child health outcomes. In the context of this study, adequacy of ANC denotes the situation whereby women receive the recommended ANC components and visits from skilled service providers.[4,6] Adequacy of ANC is compositely measured as receiving the World Health Organization (WHO) recommended number of ANC visits, a sufficient number of visits (i.e. eight or more ANC visits), early ANC initiation (i.e. first ANC visit within the first trimester of pregnancy), and receiving ANC services from skilled health personnel.[4,6] For instance, the WHO recommends that pregnant women have laboratory investigations, receive iron supplements, undergo physical examinations, and receive counselling during ANC attendance.[7]

There is consensus in the literature that disparities exist in accessing adequate ANC. Evidence from Mexico,[8] Bangladesh,[9] Ethiopia[10] and South Asia[4] has shown that ANC adequacy varies significantly with indigenous ethnicity, household wealth, educational status, and place of residence. Some studies have also found an association between women's empowerment and components of ANC.[4,11,12] For instance, Kareem et al.[12] reported that women's empowerment was significantly associated with the frequency and timeliness of ANC. However, a study in Burkina Faso indicates that the proximal determinants of ANC could not translate into empowerment to make healthcare decisions due to poor socio-economic status.[13] This raises a fundamental question: does women's empowerment and socio-economic status (WESS) predict the adequacy of ANC?

A multicountry study conducted in five Southeast Asian countries revealed that WESS predicted the adequacy of ANC.[4] However, the sociocultural context of Southeast Asian countries differs significantly from SSA. Therefore, the findings in Southeast Asia may not play out similarly in SSA. Given that SSA has the greatest burden of maternal mortality and some of the lowest ANC coverage,[2] it is imperative to investigate the role of WESS in achieving adequate ANC coverage. However, previous studies that have assessed the role of WESS in ANC have focused on only individual components of ANC, such as utilisation,[12] quality,[14] and uptake of ANC.[15] Thus, there is a paucity of empirical evidence that tests the hypothesis that WESS predicts the adequacy of ANC

Table 1. Description of study sample

Country	Year of survey	Weighted N	Weighted %
Benin	2018	6849	12.0
Cameroon	2018	4394	7.7
Gambia	2019–20	4407	7.7
Guinea	2018	4160	7.3
Liberia	2019–20	2397	4.2
Mali	2018	4772	8.3
Nigeria	2018	15 022	26.2
Rwanda	2019–20	4980	8.7
Sierra Leone	2019	5077	8.9
Zambia	2018	5206	9.1
All countries	2018–20	57 265	100.0

in SSA. This study aimed to bridge this gap in the literature by investigating whether WESS predicts the adequacy of ANC in SSA.

Methods

Data source

Data from the recent Demographic and Health Surveys (DHSs) of 10 countries in SSA were used for the study. We included countries with a survey dataset compiled from 2018 to 2020. These countries consisted of Benin, Cameroon, Gambia, Nigeria, Liberia, Mali, Rwanda, Sierra Leone, Zambia and Guinea (see Table 1). These countries had the recent dataset required for assessing the eight or more ANC visits recommended by the WHO.[16] The DHS is a comparable nationally representative survey undertaken regularly in >90 countries, enhancing a global understanding of developing country's health and demographic trends.[17] The DHS Program's major goal is to improve demographic, health and nutrition data collection, analysis and distribution, as well as to make these data more useful for planning, policymaking, and program management.[17]

Study design and sampling procedure

The DHS employs a descriptive cross-sectional design. Validated and pretested structured questionnaires are used to collect data from the respondents on health and social issues such as maternal health service utilization, women's empowerment and sociodemographic characteristics.[17,18] The survey was conducted using a two-stage cluster sampling technique. To begin, a stratified sample of enumeration areas (EAs) is chosen using probability proportional to size (PPS): a sample of a preset number of EAs is chosen independently in each stratum using probability proportional to the EA's size. A listing technique is used in the designated EAs to ensure that all dwellings/households are listed. Second, households in the selected EAs are selected using equal probability systematic sampling. A detailed procedure for sampling has been described elsewhere.[19] We included 57 265 women with complete observations on variables of interest in the study. We also adopted the Strengthening the Reporting of

Observational Studies in Epidemiology (STROBE) guidelines in drafting this manuscript.[20] The dataset is freely available to download at https://dhsprogram.com/data/available-datasets.cfm.

Variables

The outcome variable in the present study was the adequacy of ANC. This variable was assessed as an index created from three variables: ANC coverage of at least one visit, the intensity of ANC (eight or more visits), and receipt of components of ANC services. Please see Supplementary File 1, which contains the prevalence of the variables used to create the adequacy of care.

To measure the ANC coverage of at least one visit, the women were asked about the number of ANC visits they had during their recent pregnancy. The proportion of women who received at least one ANC visit with a qualified healthcare provider during the last pregnancy were said to have had ANC coverage of at least one visit. The intensity of ANC was defined as women who had eight or more ANC visits from a qualified healthcare professional, based on WHO recommendations.[16] With the receipt of the component of the ANC based on the WHO recommendations, women who had at least one ANC visit were asked whether they received specific care components during any of the consultations they attended during their pregnancy.[16] Because the components of ANC were assessed by looking at the proportion of women who had at least one ANC visit and at least one recommended component, we excluded all women without a history of ANC visits from the study. Five of the components of ANC services found uniformly across all 10 countries and included in the present study were blood pressure measurement, urine test, blood test, iron and folic acid supplementation, and tetanus injections. Women who received each of the components were coded as '1' and '0' for those with no history of receipt. An index variable called adequacy of ANC was created using the recoded response from the intensity of ANC visit and receipt of the components of ANC. All the women who had eight or more ANC visits and received all five components of the recommended ANC were categorized as having adequate ANC and coded as '1', and '0' otherwise.[4]

Women's empowerment and socio-economic status indicators were the main explanatory variables in the study. From the literature,[21] we used women's decision-making and justification of violence as indicators for women's empowerment. Socio-economic status indicators were also assessed using the level of education of the women, current working status and wealth index.

Women's decision making was assessed using responses to three questions: 'Who decides about your own health?', 'Who decides to purchase large household expenses?', and 'Who decides when you want to visit family or relatives?'. The response categories to each of the questions were 1, respondent alone; 2, respondent and husband/partner; 3, husband/partner alone; 4, someone else; and 5, other. Women who usually decided alone in at least two instances were considered as having high decision-making power. Those who usually decided alone in only one of the three instances were said to have moderate decision-making power, while the remaining women who could not decide alone in all three instances were grouped as having low decision-making power.[12,22,23]

Women's justification of intimate partner violence (IPV) was the second indicator of women's empowerment. Five questions were used to examine the women's justification of IPV. The women were asked if their husband or partner was justified for wife-beating in five instances: burning food, arguing with him, going out without telling him, neglecting the children and refusing to have sexual intercourse with him. Each item included three response options: 'no', 'yes' and 'don't know'. Those who answered 'no' or 'don't know' were recoded as 'no,' but those who answered 'yes' were kept. The dichotomized replies were then utilized to produce the justification of violence as an index variable. Those who answered 'no' to all five questions were categorised as having low justification for IPV, those who responded 'yes' to two of the questions had medium justification and those who responded 'yes' to at least three of the questions were categorised has having high justification for IPV. Literature was used to inform the coding of the rationale for justification of IPV.[12,22,23]

For the socio-economic status indicators, we maintained the existing coding as found in the DHS for level of education, wealth index and current working status. The level of education of women was coded as 'no education', 'primary', 'secondary' and 'higher'. Current working status was coded as 'no' and 'yes'. The wealth index was coded as 'poorest', 'poorer', 'middle', 'richer' and 'richest'. From the DHS, the wealth index was measured as a proxy of socio-economic status. It was calculated using component rankings derived from principal component analysis on family asset ownership, such as access to drinking water, kind of toilet, type of cooking fuel and possession of a television and refrigerator.

We considered 13 variables as covariates in the study. These variables were grouped into individual-level and household- or community-level covariates. The individual-level covariates were the woman's age, marital status, religion, partner's education level, parity, age at first birth, wanted last child when pregnant, read newspapers or magazines, watch television, listen to radio, and health insurance coverage. The sex of household head, place of residence, and the countries studied were considered as the household- or community-level covariates. All the covariates were selected based on their availability in the DHS dataset and their significant association with utilisation of ANC from the literature.[4,12,21,23]

Statistical analyses

Stata version 16.0 (StataCorp, College Station, TX, USA) was used to carry out the analysis in four steps. In the first stage, frequencies and percentages were used to summarize the results of the coverage of adequacy of ANC services across the 10 countries. We later adopted the Pearson chi-squared test of independence to examine the distribution of the adequacy of ANC care across the explanatory variables. We conducted a multicollinearity test using the variance inflation factor (VIF) to examine the collinearity among the variables. The results indicated that the minimum, maximum, and mean VIFs were 1.04, 6.70, and 2.26, respectively; hence, there was no evidence of high collinearity among the variables included in the regression analysis. To examine
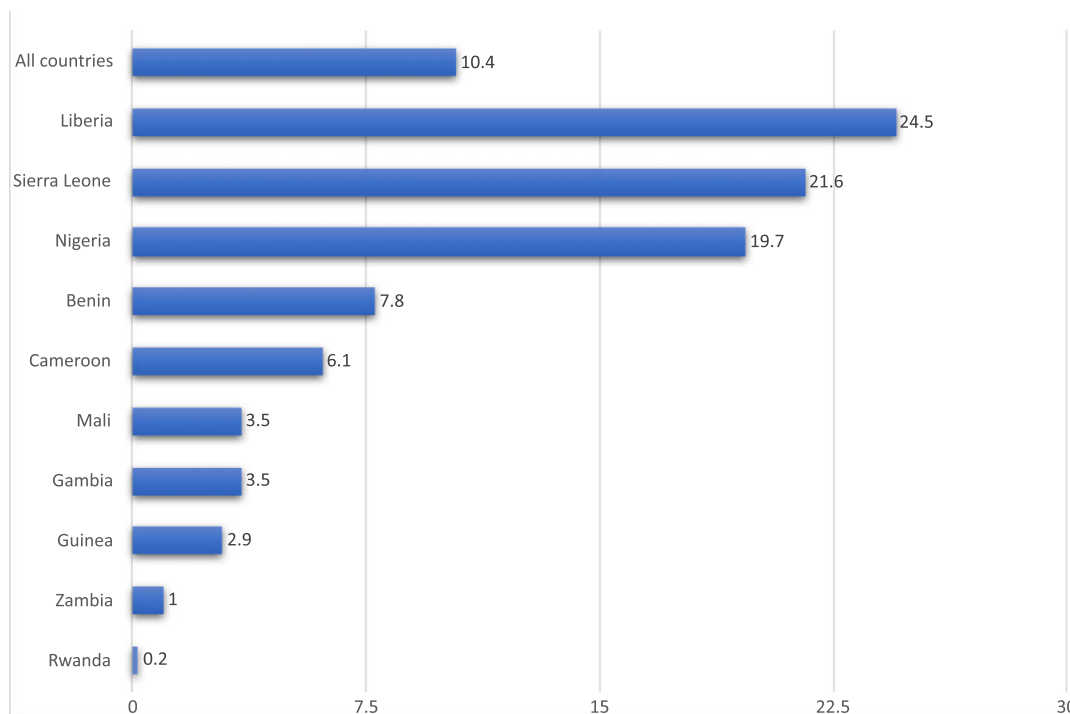
Figure 1. Prevalence of adequacy of ANC services in SSA.

the association between women's empowerment and socio-economic status indicators and adequacy of ANC, we adopted a multivariable binary multilevel regression analysis. We carried out the regression analysis using five models (Models 0–4). The first model (Model 0) revealed the variance in ANC attributed to the primary sampling unit (PSU) by being an empty model with no explanatory variables or covariates. Model 1 only included women's empowerment and socioeconomic status indicators, while Model 2 included Model 1 and individual-level variables. Model 3 included Model 1 and household or community-level variables. The last model (Model 4) included women's empowerment and socioeconomic status and household or community-level variables. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were used to present the findings of the regression analysis. Statistical significance was set at $P < .05$. In addition, all five models included fixed and random effects. Random effects denoted the measure of variation in the outcome variable based on the PSU [measured by intracluster correlation (ICC)], whereas fixed effects denoted the relationship between the explanatory variable and/or covariates and the outcome variable. Model fitness, or how well different models match the data, was assessed using the Akaike information criterion (AIC). The 'mlogit' program in Stata was used to execute the multilevel regression models. To account for disproportionate sampling and non-response, the 'svyset' command was used and weighting was done to account for the intricate nature of DHS data.

Ethical considerations

We did not obtain ethical clearance for the conduct of this study since the data are publicly available. However, permission for use was sought from the MEASURE DHS Program and approval was granted before downloading and utilizing it for the study. Before the commencement of the survey, ethical approval was obtained, and all ethical criteria governing the use of human participants were strictly adhered to. http://goo.gl/ny8T6X contains information about data and ethical standards.

Results

Prevalence of the adequacy of ANC services in SSA

Figure 1 shows the prevalence of ANC adequacy in SSA, with an average of 10.4% in all the 10 countries, ranging from 0.2% in Rwanda to 24.5% in Liberia.

Distribution of the adequacy of ANC across the explanatory variables among women in SSA

Table 2 shows the distribution of the adequacy of ANC attendance across the explanatory variables. It was found that 12.2% of those with high decision-making capacity, 13.5% of those with low justification of violence, 29.0% of those with higher education, 11.9% of those currently working and 19.8% of those in the highest wealth status had a high prevalence of adequate ANC attendance. The study also showed that 21.8% of those with higher education had adequate ANC attendance. Those who were covered by health insurance (10.9%) and those in urban areas had high prevalence of adequate ANC attendance.

Table 2. Distribution of adequacy of ANC across the explanatory variables among women in SSA

Variable	Weighted N (%)	Adequacy of ANC care, % (95% CI)	p-Value
Empowerment indicators			
Women's decision making			0.003
Low	42 679 (74.5)	10.1 (9.6 to 10.7)	
Medium	8777 (15.3)	10.3 (9.4 to 11.4)	
High	5808 (10.2)	12.2 (11.0 to 13.5)	
Justification of violence			<0.001
Low	31 160 (54.4)	13.5 (12.8 to 14.2)	
Medium	14 505 (25.3)	7.7 (7.1 to 8.4)	
High	11 600 (20.3)	5.3 (4.7 to 5.9)	
Socio-economic status			
Maternal level of education			<0.001
No education	24 198 (42.2)	6.4 (5.9 to 6.9)	
Primary	14 183 (24.8)	6.8 (6.2 to 7.4)	
Secondary	15 678 (27.4)	16.0 (15.2 to 17.0)	
Higher	3206 (5.6)	29.0 (26.7 to 31.3)	
Current working status			<0.001
No	17 447 (20.5)	6.8 (6.3 to 7.4)	
Yes	39 818 (69.5)	11.9 (11.3 to 12.5)	
Wealth index			<0.001
Poorest	11 066 (19.3)	4.9 (4.4 to 5.6)	
Poorer	11 768 (20.6)	6.2 (5.6 to 6.8)	
Middle	11 905 (20.8)	8.6 (7.9 to 9.3)	
Richer	11 686 (20.4)	12.8 (11.9 to 13.9)	
Richest	10 840 (18.9)	19.8 (18.5 to 21.2)	
Covariates			
Women's age (years)			<0.001
15–19	3089 (5.4)	5.8 (4.9 to 6.9)	
20–24	10 767 (18.8)	8.9 (8.2 to 9.7)	
25–29	157 117 (26.4)	10.6 (9.9 to 11.3)	
30–34	12 640 (22.1)	11.9 (11.1 to 12.7)	
35–39	9844 (17.2)	11.4 (10.6 to 12.3)	
40–44	4340 (7.6)	10.6 (9.5 to 11.8)	
45–49	1468 (2.5)	8.5 (7.1 to 10.2)	
Marital status			0.009
Married	50 420 (88.0)	10.2 (9.7 to 10.7)	
Cohabiting	6845 (12.0)	11.8 (10.6 to 13.2)	
Religion			<0.001
Christian	26 527 (46.3)	12.6 (11.9 to 13.3-	
Islam	28 984 (50.6)	8.7 (8.1 to 9.3)	
African traditional	844 (1.5)	5.5 (3.7 to 8.0)	
No religion/other	910 (1.6)	5.0 (3.4 to 7.3)	
Partner's level of education			<0.001
No education	21 322 (37.2)	6.2 (5.6 to 6.7)	
Primary	12 341 (21.6)	6.1 (5.6 to 6.8)	
Secondary	17 539 (30.6)	14.5 (13.7 to 15.4)	
Higher	6063 (10.6)	21.8 (20.2 to 23.5)	
Parity			<0.001
1	9650 (16.8)	11.9 (11.1 to 12.8)	
2	10 944 (19.1)	12.4 (11.5 to 13.3)	
3	9882 (17.3)	11.6 (10.7 to 12.5)	
>4	26 789 (16.8)	8.6 (8.1 to 9.1)	
Covered by health insurance			<0.001
No	51 684 (90.3)	10.9 (10.4 to 11.4)	
Yes	5581 (9.7)	5.4 (4.6 to 6.4)	

Table 2. (Continued)

Variable	Weighted N (%)	Adequacy of ANC care, % (95% CI)	p-Value
Age at first birth			<0.001
Adolescence	31 298 (54.7)	7.8 (7.3 to 8.3)	
Adult	25 967 (45.3)	13.5 (12.8 to 14.2)	
Wanted last child when pregnant			<0.001
Wanted then	45 929 (80.2)	10.8 (10.3 to 11.3)	
Wanted later	8541 (14.9)	8.6 (7.8 to 9.5)	
Wanted no more	2795 (4.9)	9.1 (7.9 to 10.4)	
Watch television			<0.001
No	30 901 (54.0)	7.5 (7.0 to 8.1)	
Yes	26 364 (46.0)	13.7 (13.0 to 14.5)	
Listening to radio			<0.001
No	23 502 (41.0)	7.9 (7.4 to 8.5)	
Yes	33 763 (59.0)	12.1(11.5 to 12.7)	
Read newspapers or magazines			<0.001
No	50 771 (88.7)	9.4 (8.9 to 9.9)	
Yes	6494 (11.3)	18.0(16.5 to 19.5)	
Sex of household head			<0.001
Male	50 348 (87.9)	10.1 (9.6 to 10.6)	
Female	6917 (12.1)	12.3 (11.4 to 13.4)	
Place of residence			<0.001
Urban	22 585 (39.4)	16.1 (15.1 to 17.1)	
Rural	34 680 (60.6)	6.7(6.2 to 7.1)	

*p-Values were generated from chi-squared test.

Association between women's empowerment indicators, socio-economic status and adequacy of ANC services in SSA

The study showed that women with medium (aOR 1.24 [CI 1.10 to 1.40]) and high (aOR 1.24 [CI 1.07 to 1.43]) decision-making power had higher odds of adequacy of ANC compared to those with low decision-making power. The study also showed that women with a higher level of education (aOR 1.63 [CI 1.36 to 1.95]) as well as their partners' high educational level (aOR 1.34 [CI 1.14 to 1.56]) had higher odds of adequacy of ANC compared to those with no formal education. It was also found that those working (aOR 1.35 [95% CI 1.23 to 1.49]), those in the richest wealth category (aOR 2.29 [CI 1.90 to 2.76]), those 40–44 y of age (aOR 1.71 [CI 1.29 to 2.28]) and those exposed to radio (aOR 1.25 [CI 1.13 to 1.38]) had higher odds of adequacy of ANC compared to those who were not working, those 15–19 y of age, and those not exposed to radio. In contrast, those with high justification of IPV against women (aOR 0.84 [CI 0.73 to 0.97]), those of the Islamic religion (aOR 0.75 [CI 0.67 to 0.84]), those with parity of four or more (aOR 0.74 [CI 0.64 to 0.86]), those who want no more children (aOR 0.79 [CI 0.66 to 0.95]), and those in rural areas (aOR 0.78 [CI 0.68 to 0.89]) had lower odds of adequacy of ANC compared to those with low justification of IPV against women, Christians, those with a parity of one, and those who wanted their last child then (Table 3).

Discussion

Main findings of this study

Drawing on the most recent nationally representative DHS datasets from 10 SSA countries, the study examined whether WESS predicts the adequacy of ANC. We found that the prevalence of ANC adequacy was low across all 10 SSA countries, with an average of 10.4%. The observed prevalence is substantially lower compared with a related study conducted among South Asian countries that reported an adequate ANC prevalence of 30%.[4] However, the prevalence is somewhat similar to the 10.2% and 11.0% ANC adequacy reported by Tebekaw et al.[24] and Bayou et al.,[10] respectively. These findings are staggering, as it implies that a substantial proportion of women in the selected SSA countries are not receiving a sufficient number of ANC visits, early ANC initiation and ANC services from skilled health personnel, making it difficult for these SSA countries to achieve SDGs 3.1 and 3.2.

On the main hypothesis tested, our study shows that WESS significantly predicted the adequacy of ANC. Compared with women with low decision-making power, those who reported high decision-making power were more likely to have adequate ANC. Closely related to this, we found that women with medium to high levels of IPV justification were less likely to have adequate ANC compared with their counterparts with a low level of violence justification. The association between these empowerment

Table 3. Association between women's empowerment indicators, socio-economic status and adequacy of ANC services in SSA

Variables	Model 0	Model 1, aOR aOR (95% CI)	Model 2, aOR aOR (95% CI)	Model 3, aOR aOR (95% CI)	Model 4, aOR aOR (95% CI)
Fixed effects					
Empowerment indicators					
Women's decision-making					
Low		1.00	1.00	1.00	1.00
Medium		1.01 (0.90 to 1.13)	1.03 (0.91 to 1.15)	1.26[***] (1.11 to 1.42)	1.24[***] (1.10 to 1.40)
High		1.10 (0.96 to 1.27)	1.10 (0.95 to 1.26)	1.26[**] (1.09 to 1.46)	1.24[**] (1.07 to 1.43)
Justification of violence					
Low		1.00	1.00	1.00	1.00
Medium		0.87[*] (0.78 to 0 .97)	0.89[*] (0.80 to 0.99)	0.87[*] (0.78 to 0.97)	0.89[*] (0.80 to 0.99)
High		0.66[***] (0.58 to 0.76)	0.69[***] (0.60 to 0.79)	0.80[**] (0.69 to 0.91)	0.84[*] (0.73 to 0.97)
Socio-economic status					
Maternal level of education					
No education		1.00	1.00	1.00	1.00
Primary		0.83[**] (0.75 to 0.93)	0.95 (0.84 to 1.07)	1.36[***] (1.21 to 1.53)	1.24[***] (1.10 to 1.40)
Secondary		1.45[***] (1.32 to 1.60)	1.33[***] (1.18 to 1.49)	1.70[***] (1.54 to 1.89)	1.36[***] (1.22 to 1.53)
Higher		2.06[***] (1.77 to 2.39)	1.76[***] (1.47 to 2.10)	2.53[***] (2.15 to 2.96)	1.63[***] (1.36 to 1.95)
Current working status					
No		1.00	1.0	1.00	1.00
Yes		1.66[***] (1.52 to 1.81)	1.67[***] (1.53 to 1.82)	1.42[***] (1.29 to 1.56)	1.35[***] (1.23 to 1.49)
Wealth index					
Poorest		1.00	1.00	1.00	1.00
Poorer		1.18[*] (1.03 to 1.36)	1.17[*] (1.01 to 1.34)	1.16[*] (1.01 to 1.33)	1.12 (0.98 to 1.29)
Middle		1.43[***] (1.22 to 1.67)	1.41[***] (1.20 to 1.66)	1.46[***] (1.25 to 1.70)	1.35[***] (1.16 to 1.58)
Richer		1.85[***] (1.56 to 2.20)	1.85[***] (1.55 to 2.21)	2.00[***] (1.70 to 2.36)	1.74[***] (1.47 to 2.06)
Richest		2.51[***] (2.11 to 2.99)	2.55[***] (2.12 to 3.07)	2.92[***] (2.44 to 3.50)	2.29[***] (1.90 to 2.76)
Random effects model					
PSU variance (95% CI)	1.934 (1.743–2.146)	1.233 (1.077–1.411)	1.179 (1.023–1.359)	0.850 (0.716–1.010)	0.767 (0.643–0.915)
ICC	0.370	0.272	0.264	0.205	0.189
Wald chi-squared	Reference	679.05 (<0.001)	1104.97 (<0.001)	1842.24 (<0.001)	2160.57 (<0.001)
Model fitness					
Log-likelihood	−17 126.37	−16 505.75	−16 200.032	−14 750.662	−14 615.886
AIC	34 256.74	33 039.5	32 474.06	29 551.32	29 327.77
Total sample included in the study	57 265	57 265	57 265	57 265	57 265
Number of clusters	1379	1379	1379	1379	1379

[*] p<0.05, [**] p<0.01, [***] p<0.001.
1 = reference category.
Model 0: empty model with no explanatory variables; Model 1: included women's decision making, justification of violence and socio-economic status (maternal level of education, current working status and wealth index); Model 2: included model 1 and woman's age, marital status, religion, partner's level of education, parity, age at first birth, wanted last child when pregnant, health insurance, read newspapers or magazines, listen to radio and watch television; Model 3: included model 1 and sex of household head, place of residence and country; Model 4: included model 1 individual and household or community level covariates.

indicators (i.e. justification of IPV and women's decision-making power) and the likelihood of having adequate ANC aligns with evidence from studies conducted in South Asian countries[4] as well as some individual sub-Saharan Africa countries, including Cameroon.[23] The literature shows that women who justify IPV are often timid and lack the necessary competencies to negotiate or make healthcare decisions.[23,25] Our findings highlight the need for radical advocacy against the endorsement of IPV. It also underscores the urgency for educational messages and interventions that will keep women abreast of the recommended

number of ANC visits, the importance of early ANC initiation and accessibility to the full ANC package.

The second aspect of the hypothesis tested shows that women's socio-economic status, signified by the maternal level of education, wealth index, and current working status, significantly predicted the adequacy of ANC after controlling for covariates. Compared with women in the poorest wealth index, those in the richest wealth index were 2.6 times more likely to have had adequate ANC, perhaps because women in the richest wealth index are more likely to reside in localities with health facilities and quality ANC services.[23] This is seen in our findings that women in rural areas are less likely to have adequate ANC. Another plausible explanation for this could be that women in the high wealth index have the financial resources and capacity to afford the full package of ANC, resulting in greater utilisation and adequate ANC. Often, women's dependency on their partners for financial resources has been cited as a key limitation to their health-seeking behavior.[26] This is reflected in the present study, as women who were currently working were more likely to have adequate ANC compared with those who were not currently working.

Further, the findings from this study show that women with higher educational attainment are significantly more likely to have adequate ANC compared with those with no formal education. This result matches the findings of previous studies.[4,27,28] The study lends credence to the findings of a related study which established that women with formal education or higher educational attainment were more likely to be aware and appreciate the benefits of seeking maternal healthcare.[29] Also, formal education tends to improve and promote women's decision-making and overall empowerment, thereby making them more confident to demand adequate ANC services. A similar association was reported in the analysis of the covariates, which showed that women whose partners had formal education were more likely to have adequate ANC. The reason could be that such partners may be more open, permissive, and supportive about women accessing ANC.

The findings from this study have important policy implications, as they show an association between WESS and the adequacy of ANC. We call on governments across SSA to prioritize and invest in women's empowerment initiatives, including advancing education for female children and women, particularly at higher education levels. Also, our findings provide empirical evidence that suggests that advocacy against the endorsement of IPV is greatly needed in SSA to strengthen women's empowerment and decision making.

Strengths and limitations

In this study we relied on recent nationally representative datasets that provide much timeliness to our study findings. We combined all available variables or indicators in the DHS, hence, our analysis and procedures are comprehensive and robust. Another strength of the study is that we were able to identify the coverage of adequate ANC as well as specific subpopulations that are lacking in that regard. This is useful to policymaking and intervention implementation.

There are some notable limitations to the study. Given the cross-sectional nature of DHS datasets, only associations can be established between WESS and the adequacy of ANC. Another limitation is that one of the components of adequate ANC (timing of ANC) is not available for all countries. As such, it was not used in this study. Also, since the questions for ANC were self-reported, there is the possibility of recall bias, which is beyond our control.

Conclusions

The adequacy of ANC was low across all 10 SSA countries included in the study. It is evident from the study that WESS significantly predicted the adequacy of ANC. Women who reported high decision-making power were more likely to have adequate ANC, while those with medium–high levels of violence justification were less likely to have adequate ANC. Higher educational attainment, current working status and higher wealth index were associated with greater odds of the adequacy of ANC. As such, promoting women's empowerment programs without intensive improvements in women's socio-economic status will yield ineffective results. However, when women's empowerment programs are combined with active improvements in socio-economic status, then women will be encouraged to demand adequate ANC.

Supplementary data

Supplementary data are available at *International Health* online.

References

1 Okedo-Alex IN, Akamike IC, Ezeanosike OB, et al. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.

2 World Health Organization. Maternal mortality. Available from: https://www.who.int/news-room/fact-sheets/detail/maternal-mortality [accessed 27 February 2022].

3 World Health Organization. Trends in maternal mortality: 1990–2015: estimates from WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organization; 2015.

4 Anik AI, Islam MR, Rahman MS. Do women's empowerment and socioeconomic status predict the adequacy of antenatal care? A cross-sectional study in five South Asian countries. BMJ Open. 2021;11(6):e043940.

5 Pervin J, Rahman SM, Rahman M, et al. Association between antenatal care visit and preterm birth: a cohort study in rural Bangladesh. BMJ Open 2020;10:e036699.

6 Heredia-Pi I, Servan-Mori E, Darney BG, et al. Measuring the adequacy of antenatal health care: a national cross-sectional study in Mexico. Bull World Health Org. 2016;94(6):452–61.

7 World Health Organization. WHO antenatal care randomized trial: manual for the implementation of the new model. Available from: https://apps.who.int/iris/handle/10665/42513 [accessed 27 February 2022].

8 Servan-Mori E, Sosa-Rubí SG, Najera-Leon E, et al. Timeliness, frequency and content of antenatal care: which is most important to reducing indigenous disparities in birth weight in Mexico? Health Policy Plan. 2016;31(4):444–53.

9 Islam MM, Masud MS. Determinants of frequency and contents of antenatal care visits in Bangladesh: assessing the extent of compliance with the who recommendations. PLoS One. 2018;13(9):e0204752.

10 Bayou YT, Mashalla YS, Thupayagale-Tshweneagae G. The adequacy of antenatal care services among slum residents in Addis Ababa, Ethiopia. BMC Pregnancy Childbirth. 2016;16(1):142.

11 Sebayang SK, Efendi F, Astutik E. Women's empowerment and the use of antenatal care services: Analysis of demographic health surveys in five Southeast Asian countries. Women Health. 2019;59(10):1155–71.

12 Kareem YO, Morhason-Bello IO, OlaOlorun FM, et al. Temporal relationship between Women's empowerment and utilization of antenatal care services: lessons from four national surveys in sub-Saharan Africa. BMC Pregnancy Childbirth. 2021;21(1):198.

13 Pambè MW, Gnoumou B, Kaboré I. Relationship between women's socioeconomic status and empowerment in Burkina Faso: a focus on participation in decision-making and experience of domestic violence. Afr Popul Stud. 2014;28(2):1146–56.

14 Merrell LK, Blackstone SR. Women's empowerment as a mitigating factor for improved antenatal care quality despite impact of 2014 Ebola outbreak in Guinea. Int J Environ Res Public Health. 2020;17(21):8172.

15 Shibre G, Zegeye B, Yeboah H, et al. Women empowerment and uptake of antenatal care services: a meta-analysis of Demographic and Health Surveys from 33 sub-Saharan African countries. Arch Public Health. 2021;79(1):87.

16 World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: World Health Organization; 2016.

17 Croft TN, Marshall AMJ, Allen CK. Guide to DHS statistics. Rockville, MD: ICF, 2018. Available from: https://dhsprogram.com/pubs/pdf/DHSG1/Guide_to_DHS_Statistics_DHS-7.pdf [accessed 22 February 2023].

18 Corsi DJ, Neuman M, Finlay JE, et al. Demographic and health surveys: a profile. Int J Epidemiol. 2012;41(6):1602–13.

19 ICF International. Demographic and Health Survey sampling and household listing manual. Calverton, MD: ICF International; 2012.

20 Von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Int J Surg. 2014;12(12):1495–9.

21 Asim M, Hameed W, Saleem S. Do empowered women receive better quality antenatal care in Pakistan? An analysis of demographic and health survey data. PLoS One. 2022;17(1):e0262323.

22 Yaya S, Uthman OA, Ekholuenetale M, et al. Women empowerment as an enabling factor of contraceptive use in sub-Saharan Africa: a multilevel analysis of cross-sectional surveys of 32 countries. Reprod Health. 2018;15(1):214.

23 Ameyaw EK, Dickson KS, Adde KS, et al. Do women empowerment indicators predict receipt of quality antenatal care in Cameroon? Evidence from a nationwide survey. BMC Womens Health. 2021;21(1):343.

24 Tebekaw Y, Mashalla YJ, Thupayagale-Tshweneagae G. The adequacy of antenatal care services among slum residents in Addis Ababa, Ethiopia. Ann Global Health 2016;82(3):527–8.

25 Dalaker J. Demographic and social characteristics of persons in poverty: 2018. Washington, DC: Congressional Research Service; 2019.

26 Shahabuddin AS, Delvaux T, Nöstlinger C, et al. Maternal health care-seeking behaviour of married adolescent girls: a prospective qualitative study in Banke District, Nepal. PLoS One. 2019;14(6):e0217968.

27 Mohammad KA, Zahura FT, Rahman MM. Importance of maternal education on antenatal care visits in Bangladesh. Bangladesh J Sci Res. 2017;30(1–2):23–33.

28 Paudel YR, Jha T, Mehata S. Timing of first antenatal care (ANC) and inequalities in early initiation of ANC in Nepal. Front Public Health. 2017;5:242.

29 Pulok MH, Sabah MN, Uddin J, et al. Progress in the utilization of antenatal and delivery care services in Bangladesh: where does the equity gap lie? BMC Pregnancy Childbirth. 2016;16(1):200.