

ORIGINAL ARTICLE

Socio-economic determinants of early antenatal care utilization in Zambia, 2007–2019: Evidence from the Demographic and Health Surveys

Wingston Felix Ng'ambi^{1*}, Cosmas Zyambo², Chigere Adoration², Alice Ngoma Hazemba², Adamson Sinjani Muula³, Twaambo Hamonga², Angel Mwiche⁴

¹Kamuzu University of Health Sciences, Department of Health Systems and Policy, Health Economics and Policy Unit, Lilongwe, Malawi

²University of Zambia, Department of Public Health and Family Medicine, Lusaka, Zambia

³Kamuzu University of Health Sciences, School of Public Health, Blantyre, Malawi

⁴Ministry of Health, Lusaka, Zambia

ABSTRACT

Background: The World Health Organisation (WHO) through its member states has implemented Focused Antenatal Care (FANC) models and 2016 ANC guidelines. Conventional analyses on ANC uptake have focused on women having at least four ANC visits regardless of when the women have such visits. Therefore, we present the uptake of at least four early ANC (ANC4+) visits amongst women of reproductive age in Zambia between 2007 and 2019 using the Zambia Demographic and Health Survey (ZDHS).

Methods: We used data from ZDHS collected between 2007 and 2019. All women aged between 15-49 years were included in this analysis. The outcome was early ANC4+ defined as having at least four ANC visits and having the first ANC visit within four months of pregnancy. Weighted

univariate, bivariate logistic regression and multivariate logistic regression was conducted in Stata version 17. To determine whether a factor was included in the model, the likelihood ratio test was used with a statistical significance of $P < 0.05$ as the threshold.

Results: Of the 20661, 11633 (56%) of the women had attended early initiation of ANC4+. We observed increasing trends in the proportion of women with early initiation of ANC4+ from 55% in 2007 to 63% in 2018/19. The main determinants of early initiation of ANC4+ were age, parity, survey year, highest education level and wealth index quintile. There was a decreasing trend in the odds in early initiation of ANC4+ with the number of parity while there was an increasing trend in the odds in early initiation of ANC4+ with higher level of education. Being from richer household was associated with reduction in the likelihood of ANC4+ (OR= 0.81, 95%CI: 0.66-0.99, $P=0.03$). Of the 12333 women with at least 4 ANC visits regardless of timing of their first visit, 27% reported

*Corresponding author:

Wingston Felix Ng'ambi,
Kamuzu University of Health Sciences, Department of Health Systems and Policy, Health Economics and Policy Unit, Lilongwe, Malawi,
Email: wingston.ngambi@gmail.com

Keywords: SSA, Zambia, ANC, ANC4+

This article is available online at: <http://www.mjz.co.zm>, <http://ajol.info/index.php/mjz>, doi: <https://doi.org/10.55320/mjz.52.5.775>

The Medical Journal of Zambia, ISSN 0047-651X, is published by the Zambia Medical Association

© This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



late for ANC.

Conclusion: The uptake of early ANC4+ increased between 2007 and 2019 in Zambia. However, there were inequalities due to age, parity, survey year, highest education level and wealth index quintile. Our current analytical approach has demonstrated that 27% of the women that would have been misclassified as having at least ANC4+ using conventional analysis were actually late for ANC. We provide some key considerations in ensuring that Zambia and other similar settings are able to achieve universal coverage of antenatal care by 2030.

INTRODUCTION

The World Health Organisation (WHO) has implemented several antenatal care (ANC) models since 2000.¹ Some of the ANC models include Focused Antenatal Care (FANC) implemented in 2000. The FANC recommends at least four ANC (ANC4+) visits for women with uncomplicated pregnancies.² Most countries in Africa have experienced reduction in maternal and child mortality because of improved health care system. Despite this several women in Africa do not complete the required minimal number of antenatal care (ANC) visits due to late presentation for ANC.³ Despite low uptake of ANC services under the FANC model, the WHO doubled the number of ANC visits in 2016 ANC guidelines.⁴ This model prioritizes person-centred healthcare, wellbeing of women and families, and a positive perinatal and maternal outcome. These guidelines are supported by evidence from high income countries (HICs) where there was reduction in perinatal death and improvements in women's perception of care-quality as compared to the FANC model.⁵

Although analyses exist in the context of Zambia on uptake of ANC services^{6, 7} and timing of ANC services.⁸ Our study is also the first to explore what factors are associated with both early initiations of ANC and attendance of four or more ANC visits using a combined outcome variable in the context of Zambia. Therefore, the present analysis is less likely to over-estimate the true proportion of women with

ANC4+ visits since mostly the women with at least 4 ANC visits since most women with at least four ANC visits but with first ANC visit was after five months tend to have pregnancy complications. Furthermore, the results of this study have potential to provide insight into potential barriers for initiation of ANC4+ visits in Zambia by providing key information to guide policy makers working in maternal and reproductive health. The aim of this study is to assess trends and socio-economic determinants of early ANC4+ utilization in Zambia, 2007–2019. The specific objectives were to: (a) estimate the proportion of women in Zambia who initiated antenatal care early and completed at least four visits (ANC4+) between 2007 and 2019;(b) assess the influence of education, wealth, parity, and residence on early ANC4+ uptake, adjusting for confounders; (c) examine trends in the uptake of key ANC services over time; and (d) explore patterns and determinants of ANC timing and frequency, with a focus on early and adequate attendance.

METHODS

Study Design

A secondary analysis of the women's questionnaire data from three Zambia Demographic and Health Surveys (ZDHS) administered between 2007 and 2019.^{9, 10, 11} This ZDHSs collected data from female participants on maternal and child health and healthcare use, contraception and women's socio-economic status. All women aged between 15-49 years were included in this analysis. Furthermore, only women that had given at least one birth during in each survey preceding five years were included in the analysis.

Sampling Procedure

The sampling frame used for the 2014 and 2018 ZDHS is the frame of the 2010 Census of Population and Housing of the Republic of Zambia (CPH)¹⁰ while the sampling frame for 2007 ZDHS was adopted from the Census of Population and Housing of the Republic of Zambia (CPH) conducted in 2000.⁹ The sampling frame is a complete list of all

census standard enumeration areas (SEAs) created for the 2000 and 2010 ZPHC depending on the wave of the ZDHS. A SEA is a geographic area that covers an average of 130 households or 600 persons. The sampling frame contains information about the SEA location, type of residence (urban or rural), and the estimated number of residential households. The ZDHS samples were stratified and selected in two stages. A total of 320 SEAs were selected with probability proportional to size in the first stage. In the second stage, 300 households were selected. Prior to selection of the households, listing of the households in the selected clusters was done.

Data Management

We combined data from the 2007, 2013-4 and 2019 ZDHS. We classified the variables as relating to external environment (rural/urban location, survey year, and region of residence), socio-demographics (age of the woman, household wealth index, education, marital status and number of children ever born), knowledge (frequency of listening to radio or watching television)) and enablers (permission to visit health services, money to pay for health services, distance to health facilities, presence of companion, and desire for pregnancy).¹² We also extracted the tests performed during ANC visits (blood, urine and blood pressure) as well as the services that were received (Iron tablets for 90+ days, HIV testing and counselling, sulfadoxine-pyrimethamine (SP)/Fansidar for malaria prophylaxis) amongst the women that had ANC.¹²

The primary outcome was whether women had four or more antenatal care visits with a skilled service provider, namely a doctor/medical officer, clinical officer, assistant clinical officer, or nurse/midwife, with the first visit occurring in or prior to the four months of pregnancy.¹² This analysis included women with their most recent birth within two years preceding each ZDHS.

Statistical Analysis

We calculated counts, weighted percentages, weighted odds ratios (OR) and their associated 95%

confidence intervals (95%CI). We performed data management and analysis using Stata version 16 (Stata Corp., Texas, USA). The weighting variable from each of the MDHS was divided by 1000000.¹³ We further calculated the equal weights for each sample cluster and divided the average weight for each cluster by three (as data from three survey rounds being used together), as illustrated by Friedman and Jang in 2002¹⁴ and used in Ng'ambi *et al.* for ANC study conducted in Malawi.¹² We conducted weighted univariate, bivariate and multivariable logistic regression analysis of the effects of each of the predictor variables on the binary endpoint of early initiation of ANC4+.¹² Multiple weighted logistic regression models were used with a forward and backward step-wise selection method. To determine whether a factor was included in the model, the likelihood ratio test (LRT) was used with a statistical significance of $P < 0.05$ as the threshold.

Ethical Considerations

The individual consent was conducted by Zambia Statistical Agency (ZSA) during the DHS 2007, 2013-14 and 2019. We obtained permission to use this data from the MEASURE DHS. The Zambia DHS datasets were downloaded from <https://www.dhsprogram.com/data/available-datasets.cfm>. As this study used secondary anonymised data, individual informed consent was not required.

RESULTS

Characteristics of women included in this study

Table 1 shows the characteristics of the women included in the study. A total of 20661 women were evaluated between 2007 and 2019. Of these 4099 (20%) were interviewed in 2007 ZDHS; 9257 (45%) were interviewed in the 2013/14 ZDHS while 7305 (36%) were interviewed in the 2018/19 ZDHS. We observed variation in the proportions of women by age group, with most of the women being aged 20-24 years while the minority were aged between 45 to 49 years (see Table 1). The median age of the

respondents was 28 years (interquartile range (IQR): 23-34). Between 2007 and 2019, the highest proportion of women had between 2 and 3 children previously (33%) while the lowest proportion of the women had one child (22%). The median number of previous children was 3 (IQR: 2-5). Most women had primary education while the minority had tertiary education (see Table 1). Nearly 44% (9290 of 20661) were from households of poor socio-economic position and we observed a higher proportion of the households from poor socio-economic position in Zambia between 2007 and 2019.

Sixty-two percent of the women were from rural areas while 38% were from the urban areas, and

more women were interviewed from rural areas (see Table 1). Although 8986 of 20661 listened to radio between 2007 and 2019, we observed a decreasing trend from 54% in 2007 to 32% in 2018/19. Overall, the minority of women (5498 of 20661) watched a television (TV) for more than once a week but the numbers watching TV increased from 23% in 2007 to 28% in 2018/19. Over the 2007 to 2019 surveys, women cited different barriers for them to access ANC, and these barriers had different trends (see Table 1). The major barriers were long distance to health facilities (39% of 20661) and lack of money to use in accessing health services (27% of 20661). Across the survey populations, most of the women were married while the lowest proportion were widowed (see Table 1).

Table 1: Characteristics of women Interviewed during the Zambia Demographic and Health Surveys Conducted between 2007 and 2019

Characteristics (n =20661)	Total		2007		2013-14		2018-19	
	n	%	N	%	n	%	n	%
Total	20661	100.0	4099	100.0	9257	100.0	7305	100.0
Age group								
15-19	1939	9.3	361	8.7	848	9.0	730	10.0
20-24	5067	24.4	1042	25.3	2139	23.0	1886	25.6
25-29	4996	24.3	1103	26.8	2262	24.5	1631	22.6
30-34	4005	19.6	782	19.2	1865	20.6	1358	18.5
35-39	2755	13.5	476	11.8	1280	13.8	999	14.0
40-44	1468	7.0	246	6.1	679	7.1	543	7.2
45-49	431	2.0	89	2.2	184	2.0	158	2.0
Number of children ever born								
1	4481	21.7	797	19.2	1890	20.4	1794	24.8
2-3	6788	33.3	1352	33.2	2996	32.9	2440	33.8
4-5	4699	22.8	988	24.1	2144	23.3	1567	21.4
6+	4693	22.2	962	23.5	2227	23.4	1504	20.0
Education level								
None	2199	10.4	520	12.7	954	10.1	725	9.6
Primary	11055	53.5	2459	60.1	4924	53.6	3672	49.5
Secondary	6587	32.1	1004	24.3	3004	32.1	2579	36.5
Tertiary	820	4.0	116	2.8	375	4.2	329	4.4

Wealth index quintile

Poorest	4750	22.5	834	20.4	2021	22.1	1895	24.1
Poorer	4540	21.2	829	20.1	2033	21.1	1678	22.0
Middle	4523	20.9	909	21.0	2134	21.6	1480	19.9
Richer	3839	19.5	935	22.9	1718	19.0	1186	18.2
Richest	3009	15.9	592	15.6	1351	16.2	1066	15.7

Residence

Urban	7608	37.6	1460	35.8	3747	39.7	2401	36.1
Rural	13053	62.4	2639	64.2	5510	60.3	4904	63.9

Sources of antenatal care knowledge

Frequency of listening to radio

Less than once a week	11670	56.4	1868	46.3	4791	51.6	5011	68.2
At least once a week	8986	43.6	2231	53.7	4461	48.4	2294	31.8

Frequency of watching television

Less than once a week	15163	71.5	3179	76.8	6549	68.7	5435	72.1
At least once a week	5498	28.5	920	23.2	2708	31.3	1870	27.9

Barriers to access antenatal care

Permission to visit health services

Big problem	803	3.8	181	4.5	283	3.0	339	4.5
Not big problem	19858	96.2	3918	95.5	8974	97.0	6966	95.5

Money to pay for health services

Big problem	5585	26.7	1360	34.4	2494	26.3	1731	22.9
Not big problem	15076	73.3	2739	65.6	6763	73.7	5574	77.1

Factors associated with early antenatal care of at least four visits

Distribution of women by number of ANC visits

The distribution of women by number of ANC visits is shown in Table 2. Of the 20661, 11633 (56%) of the women had attended early initiation of ANC4+. We observed increasing trends in the proportion of women with early initiation of ANC4+ from 55% in 2007 to 63% in 2018/19 ($P<0.001$). The proportion of women with early initiation of ANC4+ decreased with increasing number of children ever born (see Table 2). The women with tertiary education (74%) had the highest coverage of early initiation of ANC4+ compared to those from the poorest households (52%). The rural women were more likely to demonstrate early initiation of ANC4+ than the urban women (see Table 2).

Adjusted odds ratios of women having early antenatal care of at least four visits

The crude and adjusted odds ratios for early initiation of ANC4+ are presented in Table 3. There was increasing trend in the odds of women demonstrating early initiation of ANC4+ from 2007 to 2019 ($P<0.001$). There was a decreasing trend in the odds in early initiation of ANC4+ with the number of children ever born while there was an increasing trend in the odds in early initiation of ANC4+ with the level of education (Table 3). Being from richer household was associated with reduction in the likelihood of ANC4+ (OR= 0.81, 95%CI: 0.66-0.99, $P=0.03$).

Services received by antenatal care women

The services accessed by women that attended ANC in Zambia are shown in Figure 1. The proportion of

Table 2: Distribution of women with at least four ANC visits in Zambia between 2007 and 2019

Characteristics	Total				2007				2013-14				2018-19			
	<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	90	43	116	56	18	45	22	54	44	47	47	52	27	37	45	62
	28	.6	33	.4	48	.1	51	.9	59	.8	98	.2	21	.5	84	.5
Age group																
	90	46	103	53	18	48	18	51	43	51	41	48	28	40	44	59
15-19	1	.6	8	.4	0	.7	1	.3	3	.5	5	.5	8	.1	2	.9
	22	45	278	54	48	47	55	52	10	51	10	48	70	37	11	62
20-24	85	.1	2	.9	7	.1	5	.9	90	.2	49	.8	8	.2	78	.8
	22	43	279	56	47	42	62	57	11	47	11	52	62	38	10	61
25-29	02	.6	4	.4	9	.7	4	.3	02	.5	60	.5	1	.8	10	.2
	16	42	231	57	33	42	45	57	88	46	98	53	48	35	87	64
30-34	94	.2	1	.8	0	.4	2	.6	1	.8	4	.2	3	.6	5	.4
	11	41	162	58	20	44	26	55	56	43	71	56	35	36	64	63
35-39	33	.1	2	.9	8	.5	8	.5	6	.3	4	.7	9	.8	0	.2
	62	43	845	57	11	48	13	51	30	45	37	54	20	37	33	62
40-44	3	.0		.0	6	.1	0	.9	1	.4	8	.6	6	.7	7	.3
	19	45	241	54	48	57	41	42	86	46	98	53	56	35	10	64
45-49	0	.2		.8		.5		.5		.6		.4		.7	2	.3
Number of children ever born																
	18	42	259	58	34	42	45	57	89	46	10	53	65	37	11	63
1	90	.0	1	.0	4	.1	3	.9	0	.8	00	.2	6	.0	38	.0
	29	43	379	56	60	44	74	55	14	48	15	51	90	37	15	62
2-3	95	.8	3	.2	5	.7	7	.3	85	.9	11	.1	5	.2	35	.8
	20	43	266	56	43	43	55	56	10	48	11	51	56	36	10	63
4-5	31	.3	8	.7	5	.7	3	.3	34	.2	10	.8	2	.4	05	.6
	21	45	258	54	46	49	49	50	10	46	11	53	59	40	90	59
6+	12	.2	1	.8	4	.6	8	.4	50	.7	77	.3	8	.1	6	.9
Education level																
	10	48	113	51	25	49	26	50	49	52	45	47	30	41	42	58
None	60	.2	9	.8	8	.4	2	.6	8	.7	6	.3	4	.5	1	.5
	48	44	618	55	11	46	13	54	23	48	25	51	13	37	23	62
Primary	73	.3	2	.7	19	.0	40	.0	86	.4	38	.6	68	.5	04	.5
	28	43	370	56	44	43	56	56	14	47	15	52	98	38	15	61
Secondary	81	.2	6	.8	2	.1	2	.9	54	.6	50	.4	5	.5	94	.5
	21	25		74		24		75	12	30	25	69		21	26	79
Tertiary	4	.9	606	.1	29	.1	87	.9	1	.5	4	.5	64	.0	5	.0
Wealth index quintile																
	20	44	265	55	39	48	43	51	10	50	10	49	68	35	12	64
Poorest	93	.5	7	.5	8	.3	6	.7	10	.6	11	.4	5	.8	10	.2
	19	42	263	57	35	43	47	56	96	47	10	52	59	35	10	64
Poorer	07	.3	3	.7	2	.1	7	.9	3	.5	70	.5	2	.8	86	.2
	20	44	249	55	39	42	51	57	10	49	10	50	57	38	90	61
Middle	28	.2	5	.8	7	.4	2	.6	58	.1	76	.9	3	.7	7	.3
	18	47	199	52	45	48	48	51	88	51	83	48	51	42	67	57
Richer	44	.7	5	.3	4	.6	1	.4	0	.1	8	.9	0	.7	6	.3
	11	38	185	61	24	42	34	57	54	38	80	61	36	35	70	64
Richest	56	.2	3	.8	7	.2	5	.8	8	.9	3	.1	1	.1	5	.9

Characteristics	Total				2007				2013-14				2018-19			
	<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Residence	35	45	407	54	67	45	78	54	18	48	18	51	98	40	14	59
Urban	35	.4	3	.6	4	.7	6	.3	74	.7	73	.3	7	.8	14	.2
Rural	54	42	756	57	11	44	14	55	25	47	29	52	17	35	31	64
	93	.5	0	.5	74	.8	65	.2	85	.2	25	.8	34	.7	70	.3
Sources of antenatal care knowledge																
Frequency of listening to radio																
Less than once a week	50	44	657	56	86	46	10	53	23	49	24	50	18	38	31	61
	95	.0	5	.0	2	.2	06	.8	37	.1	54	.9	96	.3	15	.7
At least once a week	39	43	505	56	98	44	12	55	21	46	23	53	82	35	14	64
	28	.1	8	.9	6	.2	45	.8	17	.4	44	.6	5	.9	69	.1
Frequency of watching television																
Less than once a week	66	44	847	55	14	45	17	54	32	49	33	50	20	37	34	62
	88	.2	5	.8	48	.7	31	.3	06	.1	43	.9	34	.4	01	.6
At least once a week	23	42	315	57	40	43	52	56	12	45	14	55	68	37	11	62
	40	.2	8	.8	0	.2	0	.8	53	.0	55	.0	7	.9	83	.1
Barriers to access antenatal care																
Permission to visit health services																
	39	49		50		52		47	14	55	13	44	14	43	19	56
Big problem	3	.4	410	.6	96	.5	85	.5	8	.1	5	.9	9	.1	0	.9
	86	43	112	56	17	44	21	55	43	47	46	52	25	37	43	62
Not big problem	35	.4	23	.6	52	.8	66	.2	11	.6	63	.4	72	.3	94	.7
Money to pay for health services																
	25	45	305	55	65	48	70	51	12	48	12	51	65	37	10	62
Big problem	29	.0	6	.0	8	.2	2	.8	16	.2	78	.8	5	.9	76	.1
	64	43	857	56	11	43	15	56	32	47	35	52	20	37	35	62
Not big problem	99	.1	7	.9	90	.5	49	.5	43	.7	20	.3	66	.4	08	.6
Distance to health facilities																
	36	45	450	54	84	47	93	52	18	48	20	51	97	38	15	61
Big problem	78	.3	2	.7	1	.4	4	.6	61	.5	21	.5	6	.5	47	.5
	53	42	713	57	10	43	13	56	25	47	27	52	17	37	30	63
Not big problem	50	.6	1	.4	07	.4	17	.6	98	.3	77	.7	45	.0	37	.0
Presence of companion																
	17	44	215	55	49	44	60	55	82	48	84	51	43	37	69	62
Big problem	45	.5	2	.5	1	.2	8	.8	4	.9	5	.1	0	.6	9	.4
	72	43	948	56	13	45	16	54	36	47	39	52	22	37	38	62
Not big problem	77	.4	1	.6	57	.5	43	.5	29	.5	53	.5	91	.5	85	.5
No female provider																
	11	44	146	55	35	44	43	55	45	46	52	53	34	40	50	59
Big problem	63	.1	6	.9	5	.9	3	.1	9	.4	6	.6	9	.8	7	.2
	78	43	101	56	14	45	18	54	39	47	42	52	23	37	40	62
Not big problem	57	.5	67	.5	93	.2	18	.8	92	.9	72	.1	72	.1	77	.9

Characteristics	Total				2007				2013-14				2018-19			
	<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+		<4 ANC		ANC4+	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Marital status																
Never married	11	54.	132	45.	19	47.	20	52.	52	51.	49	48.	39	39.	61	60.
Married	11	2	0	8	0	7	8	3	5	4	4	6	6	9	8	1
Widowed	69	43.	904	56.	14	45.	17	54.	34	47.	37	52.	19	36.	34	63.
Divorced	11	3	1	7	93	6	87	4	33	2	90	8	85	6	64	4
	17	43.		56.		42.		58.		47.	10	52.		39.		60.
	9	9	240	1	44	0	66	0	89	4	7	6	46	9	67	1
	82	43.	103	56.	12	38.	19	61.	41	49.	40	50.	29	40.	43	59.
	7	9	2	1	1	4	0	6	2	3	7	7	4	4	5	6

Table 3: Crude and adjusted odds ratios for factors associated with four or more antenatal care visits in Zambia between 2007 and 2019

Characteristics (n=20661)	Crude analysis		Adjusted analysis	
	OR (95%CI)	P-value	OR (95%CI)	P-value
Age group		0.61		0.07
15-19	1.00		1.00	
20-24	1.06 (0.84-1.34)		1.16 (0.90-1.50)	
25-29	1.12 (0.89-1.43)		1.36 (1.02-1.83)	
30-34	1.20 (0.94-1.53)		1.57 (1.13-2.19)	
35-39	1.25 (0.96-1.63)		1.79 (1.24-2.59)	
40-44	1.16 (0.85-1.57)		1.74 (1.15-2.64)	
45-49	1.06 (0.66-1.71)		1.65 (0.94-2.89)	
Year		<0.001		<0.001
2007	1.00		1.00	
2013-14	0.90 (0.76-1.06)		0.86 (0.73-1.02)	
2018-19	1.37 (1.15-1.63)		1.30 (1.09-1.55)	
Number of children ever born		0.59		0.19
1	1.00		1.00	
2-3	0.93 (0.78-1.10)		0.82 (0.67-1.00)	
4-5	0.95 (0.79-1.14)		0.75 (0.57-0.98)	
6+	0.88 (0.73-1.06)		0.63 (0.56-0.87)	
Education level		<0.001		<0.001
None	1.00		1.00	
Primary	1.17 (0.95-1.44)		1.21 (0.98-1.50)	
Secondary	1.22 (0.98-1.52)		1.25 (0.98-1.59)	
Tertiary	2.67 (1.79-3.97)		2.35 (1.50-3.67)	

Characteristics (n=20661)	Crude analysis		Adjusted analysis	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Wealth index quintile		0.006		0.03
Poorest	1.00		1.00	
Poorer	1.09 (0.91-1.32)		1.09 (0.90-1.31)	
Middle	1.01 (0.84-1.22)		0.99 (0.82-1.20)	
Richer	0.88 (0.73-1.06)		0.81 (0.66-0.99)	
Richest	1.30 (1.06-1.59)		1.00 (0.79-1.27)	
Residence		0.07		
Urban	1.00			
Rural	1.12 (0.99-1.28)			
Sources of antenatal care knowledge				
Frequency of listening to radio		0.60		
Less than once a week	1.00			
At least once a week	1.03 (0.91-1.17)			
Frequency of watching television		0.25		
Less than once a week	1.00			
At least once a week	1.08 (0.94-1.24)			
Barriers to access antenatal care				
Permission to visit health services		0.14		
Big problem	1.00			
Not big problem	1.28 (0.93-1.76)			
Money to pay for health services		0.27		
Big problem	1.00			
Not big problem	1.08 (0.94-1.24)			
Distance to health facilities		0.09		
Big problem	1.00			
Not big problem	1.12 (0.98-1.27)			
Presence of companion		0.59		
Big problem	1.00			
Not big problem	1.04 (0.89-1.22)			
No female provider		0.80		
Big problem	1.00			
Not big problem	1.03 (0.85-1.23)			
Marital status		0.78		
Never married	1.00			
Married	1.11 (0.91-1.35)			
Widowed	1.08 (0.67-1.73)			
Divorced	1.08 (0.82-1.42)			

women that had a blood sample taken for full blood count increased from 61% in 2007 to 96% in 2018/19 ($P < 0.001$). Similarly, there was increasing trend in the proportion of women with urine test from 23% in 2007 to 64% in 2018/19 ($P < 0.001$). We also observed an increasing trend in the proportion of ANC women that were given at least two doses of Fansidar/SP for malaria prophylaxis from 86% in 2007 to 95% in 2018/19 ($P < 0.001$). The percentage of women that had HIV testing at ANC increased from 46% in 2007 to 70% in 2013/14 and 67% in 2018/19. There was an increase in the proportion of women with blood pressure measurement from 81% in 2007 to 94% in 2018/19. We observed increasing trend in the percentage of women that received iron tablets from 91% to 97% (see Figure 1).

Timing of antenatal care visits

The median time of presenting for the first ANC care was 4 months (IQR: 3-5). Over the time period, there

is strong evidence of association between timing of first ANC visit by survey year ($P < 0.001$). The characteristics of women with at least four ANC visits regardless of the timing of the first ANC visit are shown in Table 4. A total of 12333 women had at least 4 ANC visits regardless of timing of their first visit. Of these, 9004 (73%) started ANC after the fourth month of pregnancy. Between 2007 and 2019, we observed a decreasing trend in the proportion of women who attended their first ANC visit after four months from 40% in 2007 to 19% in 2018/19. There was increasing trend in proportion of women with late attendance of ANC by parity (see Table 4). In addition, increasing level of education was associated with decreasing trend in the proportion of women with early attendance of ANC from 26% amongst those with no education to 21% amongst those with tertiary education.

Figure 1: Services received by women that attended antenatal care in Zambia between 2007 and 2019

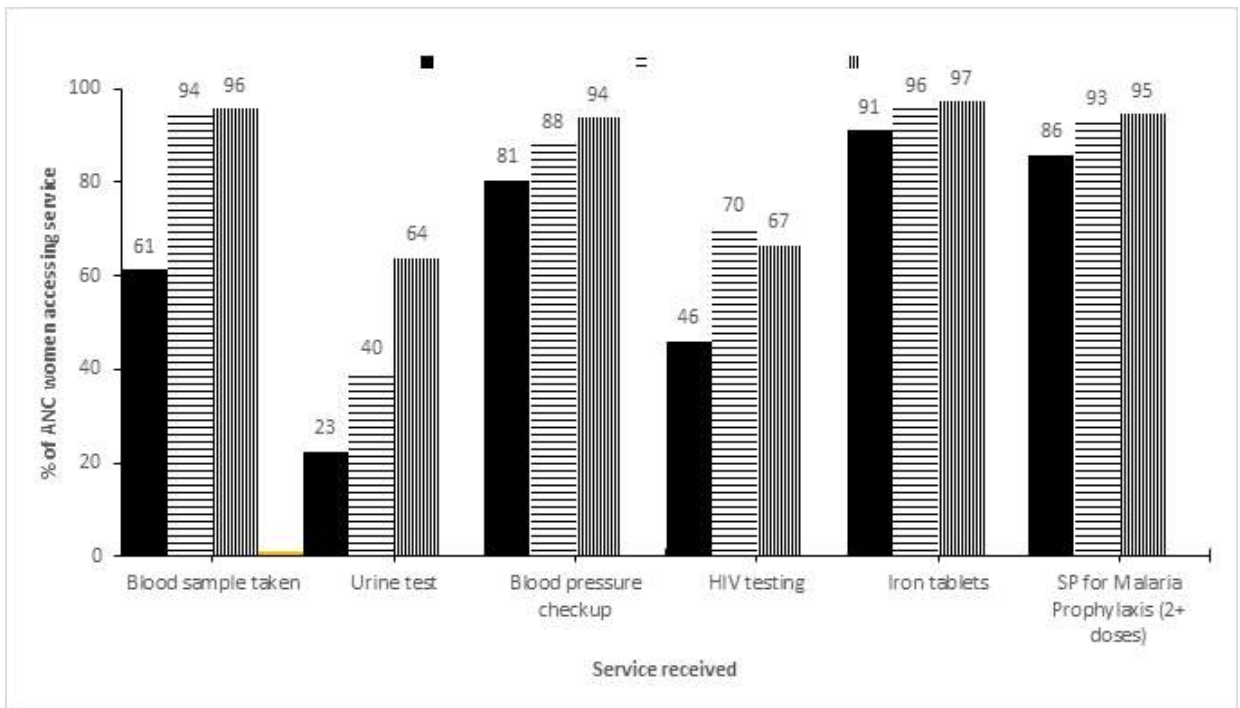


Table 4: Distribution of women with at least four antenatal care visits by the socio-demographic characteristics of the women in Zambia between 2007 and 2019

Characteristics (n=12333)	ANC attendance for women with ANC4+			
	Early		Late	
	n	%	n	%
Total	9004	73.0	3329	27.0
Age group				
15-19	795	72.0	295	28.0
20-24	2159	74.3	765	25.7
25-29	2177	74.0	771	26.0
30-34	1784	72.6	670	27.4
35-39	1247	71.7	489	28.3
40-44	650	70.8	264	29.2
45-49	192	72.2	75	27.8
Year				
2007	1496	59.7	1013	40.3
2013-14	3639	71.8	1445	28.2
2018-19	3869	81.4	871	18.6
Number of children ever born				
1	2002	73.8	712	26.2
2-3	2965	74.5	1028	25.5
4-5	2068	72.4	771	27.6
6+	1969	70.6	818	29.4
Education level				
None	892	73.8	311	26.2
Primary	4768	72.3	1803	27.7
Secondary	2850	73.0	1086	27.0
Tertiary	494	79.0	129	21.0
Wealth index quintile				
Poorest	2107	75.1	689	24.9
Poorer	2081	75.5	668	24.5
Middle	1896	71.9	765	28.1
Richer	1464	68.1	698	31.9
Richest	1456	73.8	509	26.2
Residence				
Urban	3044	70.0	1328	30.0
Rural	5960	74.8	2001	25.2
Sources of antenatal care knowledge				
Frequency of listening to radio				
Less than once a week	5154	74.2	1785	25.8
At least once a week	3850	71.5	1544	28.5

Characteristics (n=12333)	ANC attendance for women with ANC4+			
	Early		Late	
	n	%	n	%
Frequency of watching television				
Less than once a week	6566	73.2	2400	26.8
At least once a week	2438	72.5	929	27.5
Barriers to access antenatal care				
Permission to visit health services				
Big problem	316	71.7	127	28.3
Not big problem	8688	73.1	3202	26.9
Money to pay for health services				
Big problem	2344	72.2	912	27.8
Not big problem	6660	73.3	2417	26.7
Distance to health facilities				
Big problem	3488	73.4	1257	26.6
Not big problem	5516	72.8	2072	27.2
Presence of companion				
Big problem	1650	73.0	608	27.0
Not big problem	7354	73.0	2721	27.0
No female provider				
Big problem	1097	71.2	451	28.8
Not big problem	7907	73.3	2878	26.7
Marital status				
Never married	977	69.9	421	30.1
Married	7027	73.3	2567	26.7
Widowed	185	71.3	76	28.7
Divorced	815	75.1	265	24.9

DISCUSSION

This is the first analysis of both early initiations of ANC and attendance of four or more ANC visits using a combined outcome in the context of Zambia using DHS data collected between 2007 and 2019. The uptake of early ANC4+ in Zambia was 56% and this was almost twice the early ANC4+ visits reported in Malawi between 2004 and 2016 by Ng'ambi *et al.*¹² The differences in the uptake of early ANC4+ is attributable to the existing policy frameworks in these countries with the Zambia ANC policy guidelines where the majority of women accessed the ANC in the first trimester.^{6,15}

We observed an increasing trend in early ANC4+ uptake over time between 2007 and 2019. The observed trend in early ANC4+ is similar to what was observed in Malawi.¹² Furthermore, a multi-country analysis of the countries in the East Africa region also observed increasing trend in the uptake of ANC4+ visits.¹⁶ The increasing trend in the uptake of early ANC4+ is mainly due to increased commitment of these countries in implementing the global and local interventions aimed at providing quality ANC4+ services to women in these settings.¹⁷

In this study we observed a decreasing trend in the uptake of early ANC4+ with increasing parity. Other similar studies have also observed a similar trend in uptake of early ANC4+ with increasing parity.^{12, 16} The observed pattern is mainly because the women who have more children feel more experienced with pregnancy due to previous pregnancies and end up reporting late for ANC. Besides the women with higher parity may also be ashamed with their current pregnancies and hence find themselves not willing to report early for ANC and this is mainly the case with unwanted pregnancies.

We also observed that women from richer households were less likely to have early ANC4+ than the women from poorest households. The findings from this study are different from what has been observed in sub-Saharan Africa (SSA)¹⁸ or in

Malawi.¹² The differences may be attributable to different socio-cultural environment in which the ANC guidelines are implemented. The unexpected finding that women from richer households were less likely to initiate early antenatal care with at least four visits (ANC4+) suggests a possible wealth paradox. One plausible explanation could be that women in wealthier households may prioritize alternative forms of maternal care, such as private or home-based services, which may not be fully captured by standard ANC metrics.^{19, 20} Additionally, time constraints due to employment or other obligations might lead to delayed initiation or fewer clinic-based visits.²¹ Cultural perceptions around the necessity of frequent ANC among wealthier or more educated women could also influence care-seeking behaviour, highlighting the need for nuanced, context-specific interpretations.

In this study, there was an increasing trend in the uptake of early ANC4+ with increasing education. This is similar to what was observed in Malawi on a study that looked at the uptake of early ANC4+ . Furthermore, a multi-country study involving 36 countries in SSA also found huge inequalities in uptake of ANC by woman's highest level of education in which those with lower education had lower uptake of ANC.¹⁸ Therefore, Zambia should potentially invest in education so that disparities that occur as a result of lower education get reduced or eliminated completely hence achieving the universal health coverage of the ANC on one hand and other health outcomes that are sensitive to education.

There has been increasing trend in the services offered within the ANC in Zambia except the HIV testing. However, other settings like Malawi¹² and Uganda²² have higher HIV testing in the ANC than what has been observed in Zambia. The slight decline in HIV testing coverage at antenatal care from 70% in 2013/14 to 67% in 2018/19 may reflect shifts in program priorities, data reporting inconsistencies, or reduced availability of testing supplies in some facilities during that period. While the decrease is modest, it interrupts the upward trend

observed in earlier years and suggests a need for renewed focus on sustaining high testing coverage within ANC settings. The ANC is one of the critical service delivery point for identifying the women for prevention and elimination of the HIV transmission from the mother to child.^{22, 23, 24, 25, 26} The observed HIV testing uptake amongst the ANC women in Zambia was quite below the UNAIDS 95% target for HIV testing.²⁷ There is need to integrate the HIV testing to be part of the routine ANC services in order to move towards universal HIV testing amongst the ANC women.

The main limitation of the current approach to analysing the ANC4+ visits is that it minimizes the risk of over-reporting the women with ANC4+ visits. In this study, 27% of the women that would have been misclassified as having at least 4 ANC visits reported late for ANC and their frequent visits were due to pregnancy related complications. Some of the limitations in this study are (a) that the analysis does not include data on quality of the ANC services received by the women in Zambia, (b) although hypertension, diabetes and previous HIV status prior to the current pregnancy might affect ANC uptake, the ZDHS did not capture these hence they were not included in this analysis, and (c) although ZDHS collected information on HIV testing, there is no information on the timing of the captured HIV testing to the pregnancy. As with most DHS, the reliance on self-reported information introduces the potential for recall bias, particularly regarding the timing and number of antenatal care visits. This limitation may lead to over- or underestimation of service utilization, thereby affecting the accuracy of trends and associations drawn from the data.

CONCLUSION

In conclusion, the uptake of early uptake of ANC4+ increased between 2007 and 2019 in Zambia. However, there were inequalities due to wealth, education and parity. Our current analytical approach has demonstrated that 27% of the women that would have been misclassified as having at least

ANC4+ using conventional analysis were late for ANC. The countries should put in place careful measures in implementing the 2016 ANC guidelines since it has been demonstrated that achieving at least four timely ANC visits has been a tall order. The findings provide some key considerations in ensuring that Zambia and other similar settings can achieve universal coverage of antenatal care by 2030.

FUNDING

No funding for this analysis.

CONFLICT OF INTEREST

The authors have declared that no competing interests exist.

REFERENCES

1. Villar J, Ba'aqeel H, Piaggio G, Lumbiganon P, Belizán JM, Farnot U, et al. WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. *The Lancet*. 2001 May 19;357(9268):1551–64.
2. Mchenga M, Burger R, von Fintel D. Examining the impact of WHO's Focused Antenatal Care policy on early access, underutilisation and quality of antenatal care services in Malawi: a retrospective study. *BMC Health Serv Res*. 2019 May 8;19(1):295.
3. Andegiorgish AK, Elhoumed M, Qi Q, Zhu Z, Zeng L. Determinants of antenatal care use in nine sub-Saharan African countries: a statistical analysis of cross-sectional data from Demographic and Health Surveys. *BMJ Open*. 2022 Feb 1;12(2):e051675.
4. WHO recommendations on antenatal care for a positive pregnancy experience [Internet]. Apps.who.int. 2016 [cited 12 August 2020]. Available from : <https://apps.who.int/iris/bitstream/handle/10665/250796/9789241549912-eng.pdf?sequence=1>.
5. Vogel JP, Habib NA, Souza JP, Gülmezoglu AM, Dowswell T, Carroli G, et al. Antenatal care packages with reduced visits and perinatal

- mortality: a secondary analysis of the WHO Antenatal Care Trial. *Reprod Health*. 2013;10(1):1–7.
6. Chama-Chiliba CM, Koch SF. Utilization of focused antenatal care in Zambia: examining individual- and community-level factors using a multilevel analysis. *Health Policy Plan*. 2015 Feb 1;30(1):78–87.
7. Kyei NNA, Campbell OMR, Gabrysch S. The Influence of Distance and Level of Service Provision on Antenatal Care Use in Rural Zambia. *PLOS ONE*. 2012 Oct 4;7(10):e46475.
8. Nyambe S, Lungowe S, Choolwe J, Patrick M, Charles M. Factors associated with late antenatal care booking: population based observations from the 2007 Zambia demographic and health survey. *PAMJ* [Internet]. 2016 Oct 24 [cited 2022 Aug 12];25(109). Available from: <https://www.panafrican-med-journal.com/content/article/25/109/full>
9. Central Statistical Office/Zambia, Ministry of Health/Zambia, Tropical Disease Research Centre/Zambia, University of Zambia. Zambia Demographic and Health Survey 2007 [Internet]. Calverton, Maryland, USA: Central Statistical Office/Zambia and Macro International; 2009. Available from: <http://dhsprogram.com/pubs/pdf/FR211/FR211.pdf>
10. Central Statistical Office/Zambia, Ministry of Health/Zambia, University of Zambia Teaching Hospital Virology Laboratory, University of Zambia Department of Population Studies, Tropical Diseases Research Centre/Zambia, ICF International. Zambia Demographic and Health Survey 2013-14 [Internet]. Rockville, Maryland, USA: Central Statistical Office/Zambia, Ministry of Health/Zambia, and ICF International; 2015. Available from: <http://dhsprogram.com/pubs/pdf/FR304/FR304.pdf>
11. Zambia Statistics Agency - ZSA, Ministry of Health - MOH, University Teaching Hospital Virology Laboratory - UTH-VL, ICF. Zambia Demographic and Health Survey 2018 [Internet]. Lusaka, Zambia: ZSA, MOH, UTH-VL and ICF; 2020. Available from: <https://www.dhsprogram.com/pubs/pdf/FR361/FR361.pdf>
12. Ng'ambi WF, Collins JH, Colbourn T, Mangal T, Phillips A, Kachale F, et al. Socio-demographic factors associated with early antenatal care visits among pregnant women in Malawi: 2004–2016. *PLOS ONE*. 2022 Feb 8;17(2):e0263650.
13. Croft Trevor N., Marshall Aileen M. J., Allen Courtney K., et al. 2018. Guide to DHS Statistics. Rockville, Maryland, USA: ICF. Available from: https://www.dhsprogram.com/pubs/pdf/DHS_G1/Guide_to_DHS_Statistics_DHS-7_v2.pdf.
14. Friedman EM, Jang D. & Williams TV. (2002) Combined estimates from four quarterly survey data sets. Proceedings of the American Statistical Association Joint Statistical Meetings—Section on Survey Research Methods, pp.1064–1069. Alexandria, VA: American Statistical Association.
15. Ministry of Health. ANC guidelines for a positive pregnancy experience. Lusaka, Zambia; 2022. Available from: <https://www.afro.who.int/sites/default/files/2020/06/Draft%20ANC%20Guidelines%202018%20-%20Final%20Copy.pdf>
16. Mlandu C, Matsena-Zingoni Z, Musenge E. Trends and determinants of late antenatal care initiation in three East African countries, 2007–2016: A population based cross-sectional analysis. *PLOS Glob Public Health*. 2022 Aug 15;2(8):e0000534.
17. WHO. WHO recommendation on antenatal care contact schedules [Internet]. WHO, Geneva, Switzerland; [cited 2022 Aug 18]. Available from: <https://srhr.org/rhl/article/who-recommendation-on-antenatal-care-contact-schedules-2#:~:text=>

- The%20focused%20ANC%20(FANC)%20model,between%2036%20and%2038%20weeks.
18. Obse AG, Ataguba JE. Explaining socioeconomic disparities and gaps in the use of antenatal care services in 36 countries in sub-Saharan Africa. *Health Policy Plan*. 2021 Jun 3;36(5):651–61.
 19. Kim ET, Singh K, Speizer IS, Angeles G, Weiss W. Availability of health facilities and utilization of maternal and newborn postnatal care in rural Malawi. *BMC Pregnancy Childbirth*. 2019 Dec 17;19(1):503.
 20. Mukesh Adhikari, Manish Rajbanshi, Anita Karki, Richa Aryal, Bishnu Prasad Choulagai. Assessment of maternal healthcare services among the women of reproductive age in the rural municipality of Nepal: a cross-sectional study. *BMJ Public Health*. 2025 Feb 8;3(1):e000916.
 21. Mgata S, Maluka SO. Factors for late initiation of antenatal care in Dar es Salaam, Tanzania: A qualitative study. *BMC Pregnancy Childbirth*. 2019 Nov 12;19(1):415.
 22. Gunn JKL, Asaolu IO, Center KE, Gibson SJ, Wightman P, Ezeanolue EE, et al. Antenatal care and uptake of HIV testing among pregnant women in sub-Saharan Africa: a cross-sectional study. *J Int AIDS Soc*. 2016;19(1):20605.
 23. Ministry of Health. Zambia Consolidated Guidelines for Treatment and Prevention of HIV Infection [Internet]. MoH, Zambia; [cited 2022 Aug 18]. Available from: <https://www.moh.gov.zm/wp-content/uploads/filebase/Zambia-Consolidated-Guidelines-for-Treatment-and-Prevention-of-HIV-Infection-2020.pdf>
 24. Consolidated guidelines on HIV prevention, testing, treatment, service delivery and monitoring: recommendations for a public health approach. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.
 25. Awopegba OE, Kalu A, Ahinkorah BO, Seidu AA, Ajayi AI. Prenatal care coverage and correlates of HIV testing in sub-Saharan Africa: Insight from demographic and health surveys of 16 countries. *PLOS ONE*. 2020 Nov 9;15(11):e0242001.
 26. Staveteig S, Wang S, Head SK, Bradley SEK, Nybro E. Demographic patterns of HIV testing uptake in sub-Saharan Africa [Internet]. Calverton, Maryland, USA: ICF International; 2013. (DHS Comparative Reports No. 30). Available from: <http://dhsprogram.com/pubs/pdf/CR30/CR30.pdf>
 27. UNAIDS. HIV testing and counselling [Internet]. UNAIDS; [cited 2022 Aug 18]. Available from: <https://www.unaids.org/en/keywords/hiv-testing-and-counselling>