

A Multilevel Analysis of Predictors of Early Antenatal Care Visits among Women of Reproductive Age in Benin: 2017/2018 Benin Demographic and Health Survey

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Abstract—Maternal mortality, particularly in Benin, is a major public health concern in sub-Saharan Africa. To provide a positive pregnancy experience and reduce maternal morbidities, all pregnant women must get appropriate and timely prenatal support. However, many pregnant women in developing countries, including Benin, begin Antenatal Care (ANC) late. There is a paucity of empirical literature on the prevalence and predictors of early ANC visits in Benin. As a result, the purpose of this study is to investigate the prevalence and predictors of early ANC visits among women of reproductive age in Benin. This is a secondary analysis of the 2017/2018 Benin Demographic and Health Survey (BDHS) data. The study involved 6,919 eligible women. Data analysis was conducted using Stata version 14.2 for Mac OS. We adopted a multilevel logistic regression to examine the predictors of early ANC visits in Benin. The results were presented as odds ratios (ORs) associated with 95% confidence intervals (CIs) and p -value < 0.05 to determine the significant associations. The prevalence of early ANC visits among pregnant women in Benin was 57.03% [95% CI: 55.41-58.64]. In the final multilevel logistic regression, early ANC visit was higher among women aged 30-34 [aOR = 1.60, 95% CI = 1.17-2.18] compared to those aged 15-19, women with primary education [aOR = 1.22, 95% CI = 1.06-1.42] compared to the non-educated women, women who were covered by health insurance [aOR = 3.03, 95% CI = 1.35-6.76], women without a big problem in getting the money needed for treatment [aOR = 1.31, 95% CI = 1.16-1.49], distance to the health facility, not a big problem [aOR = 1.23, 95% CI = 1.08-1.41], and women whose partners had secondary/higher education [aOR = 1.35, 95% CI = 1.15-1.57] compared with those who were not covered by health insurance, had big problem in getting money needed for treatment, distance to health facility is a big problem and whose partners had no education respectively. However, women who had four or more births [aOR = 0.60, 95% CI = 0.48-0.74] and those in Atacora Region [aOR = 0.50, 95% CI = 0.37-0.68] had lower odds of early ANC visit. This study revealed a relatively high prevalence of early ANC visits among women of reproductive age in Benin. Women's age, educational status of women and their partners, parity, health insurance coverage, distance to health facilities, and region were all associated with early ANC visits among women of reproductive in Benin. These factors ought to be taken into account when developing ANC policies and strategies in order to boost early ANC visits among women in Benin. This will significantly reduce maternal and newborn mortality and help achieve the World Health Organization's recommendation that all pregnant women should initiate early ANC visits within the first three months of pregnancy.

Keywords—Antenatal care, Benin, maternal health, pregnancy,

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DHS, public health.

I. INTRODUCTION

ANC is primarily concerned with minimizing, if not eliminating, malnutrition and lowering low birth weight and infant mortality [1], [2]. ANC is a component of Benin's decent employment initiatives aimed at improving the health of pregnant women [3]. ANC provided by a health professional improves pregnancy outcomes by recognizing and addressing pregnancy-related problems [4], [5].

ANC visits provide a foundation for evidence-based clinical treatments, maternal health counseling, safe birthing, and emergency preparation. The World Health Organization (WHO) recommends four ANC checkups for all women with uncomplicated pregnancies [6]. The WHO advises that women receive tetanus toxoid vaccination, intermittent preventative malaria therapy, deworming, iron and folic acid, and insecticide-treated bed nets during ANC [7].

Maternal mortality is a major public health concern worldwide, with an estimated 810 women dying each day as a result of pregnancy-related problems [8]. Since 2020, the WHO has documented around 287,000 maternal fatalities during and after pregnancy and delivery. Around 95% of these deaths occurred in low-and-middle-income countries, with sub-Saharan Africa (SSA) accounting for 70% of the projected global maternal mortality burden [9]. These have prompted demands for more action to address the issue, as outlined in SDG three, which aims to reduce global maternal death rates to less than 70 per 100,000 live births by 2030 [10]. Among the approaches to this challenge is the timely use of prenatal care, which remains vital, specifically in SSA. The maternal mortality rate (MMR) and infant mortality rate (IMR) are the two of the most significant maternal and child health indicators [11].

The timing of the initial ANC visit is critical since it aids in the planning of subsequent visits [3]. The WHO's updated framework on continuity, and coordination of care report highlighted the significance of comprehensive and person-centered care at every visit [12]. Despite the updated recommendations, 69% of pregnant women in SSA countries received at least one ANC visit, demonstrating that the majority

of women during pregnancy do not initiate ANC as prescribed. According to the findings, most SSA countries are making much slower progress toward meeting the WHO-mandated minimum number of ANC visits [11], [13].

Geographic conditions (living in rural/urban areas), economic status, birth spacing, giving birth without the assistance of health workers or skilled attendants, cultural values adopted by an individual, maternal age, educational level, planned pregnancies, and timing of first ANC visit are some of the significant predictors associated with early initiation of ANC visits [5], [14], [15]. Moreover, exposure to the media, family income, and access to obstetric services have also been linked to higher prenatal care usage [16]-[19].

Access to maternal healthcare services in Benin has witnessed a marginal decline from 86% in 2011 to 83% in 2018 [20]. Benin, like many other SSA countries, has a disproportionate share of poor maternal health outcomes, such as pregnancy-related complications and deaths. Studies on ANC visits, access to and utilization of skilled birth attendants, and postnatal care have all been demonstrated to be crucial in avoiding mother and infant mortality [3], [5].

There is a lot of empirical research on maternal healthcare service use in Benin [3], [5], [13], [21], but there is no empirical study of early ANC visit among women of reproductive age. As a result, the aim of this research is to look at the prevalence and predictors of early ANC visits among women of reproductive in Benin. This study is expected to provide policy and strategy guidelines for strengthening ANC coverage in Benin.

II. MAIN

A. Data Source and Study Population

Data from the 2017/2018 BDHS was used for this study. The 2017/2018 BDHS, the fifth edition of the Demographic and Health Survey (DHS) was executed and coordinated by l'Institut National de la Statistique et de l'Analyse Economique (INSAE) under the supervision of the Ministry of Planning and Development. The data collection was from November 2017 to February 2018 among 15,928 women of reproductive age. The survey had technical assistance from the Inner-City Fund (ICF) International and financial support from the United States Agency for International Development (USAID), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), World Bank and other agencies and organizations.

The DHS follows standardized procedures such as sampling, questionnaires, data collection, cleaning, coding, and analyses, allowing for comparison across countries. Details of the methodology, instruments, pretesting of the instruments, training and recruitment of enumerators are documented in the final report of the 2017/2018 BDHS [22].

B. Study Population and Inclusion Criteria

For this analysis, we used women's file with a total weighted sample of 6,919 eligible women aged 15 to 49 years found the selected clusters. This included all reproductive aged women who gave birth in the five years preceding the survey. The study

included only women who had complete information on ANC visits. Therefore, women who had no ANC visit and unknown first date of ANC visit were excluded.

III. DESCRIPTION OF VARIABLES

A. Outcome Variable

The outcome variable for the study was an ANC visit. The variable was derived from the question "timing of 1st antenatal check." Based on the literature, the responses which were in months were dichotomized as early ANC visit = 1, if respondents visited ANC within the first trimester while late ANC visit = 0, denoting the first visit after the first trimester [23]-[25].

B. Independent Variables

19 variables were investigated in this study and grouped into individual and household/community-level variables. These variables were determined a priori based on literature and likelihood to influence early ANC visits [23], [25], [26].

C. Individual-Level Factors

The individual-level factors included age (15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49); education (no formal education, primary level, secondary/higher); partner's education (no formal education, primary level, secondary/higher); marital status (married, cohabitation); employment status (not working, working); parity (one birth, two births, three births, four or more births); healthcare decision making-capacity (alone, not alone), religion (traditional, Islam, Christian, no religion); getting permission to go (big problem, not a big problem); getting money needed for treatment (big problem, not a big problem); and distance to health facility (big problem, not a big problem). Other individual variables are health insurance coverage (no, yes) and media mass exposure (no, yes). Listening to radio, watching television, and reading newspaper/magazine were coded as media exposure. These three variables had the same response options; "not at all", "less than once a week", and "at least once a week". Based on literature, we grouped the response options into "No" which meant no mass media exposure (not at all) and "Yes" to mean mass media exposure (less than once a week and at least once a week) [27], [28].

D. Household/Community-Level Factors

The household/community-level variables were region (Alibori, Atacora, Atlantic, Borgou, Collines, Couffo, Donga, Littoral, Mono, Oueme, Plateau, Zou); sex of household head (male, female); wealth (poorest, poorer, middle, richer, richest), place of residence (urban, rural); community literacy level (low, medium, high); and community socioeconomic status (low, moderate, high). The community literacy level is measured as the proportion of women who completed at least primary education. Community socioeconomic status was calculated based on employment, wealth, and education of the women who lived in a certain community. To calculate the number of women who were unemployed, uneducated, and poor, we used principal component analysis. With a mean score of 0 and a

standard deviation, a standardized score was created. The scores were then divided into tertiles 1 (least disadvantaged), 2 (middle disadvantaged), and 3 (most disadvantaged), where tertile 1 represented higher socioeconomic position and tertile 3 represented poorer socioeconomic status [29].

E. Data Analysis

Stata version 14.2 for Mac OS was used for this data analysis. We performed descriptive, bivariate, and multivariate logistic regression analyses. To characterize the research sample, descriptive analysis was used. Pearson's chi-square (χ^2) was used in the bivariate analysis to investigate the relationships between early ANC visits and all of the explanatory factors in Table I. Variables that demonstrated statistical significance (at a 5% margin) in the bivariate analysis were moved to the multilevel logistic regression model. The findings of the multilevel logistic regression analysis were provided as adjusted odds ratios (aOR) with 95% CIs. The multicollinearity test revealed no evidence of collinearity among the explanatory variables using the variance inflation factor (VIF) (mean VIF = 1.52).

The multilevel regression was performed to identify the variables that influence the outcome variable (early ANC visit) at each level of the independent variables (individual level variables and household/community level variables). In Table II, four models were constructed. The first model (Model 0) was the empty model, which had no explanatory variable but showed the variance of the outcome variable attributable to the distribution of the primary sampling units. The second model contained only the individual-level factors (Model 1), while Model 2 had only the household/community-level factors. The final model (Model 3) was the complete model that controlled for the individual and household/community-level factors.

The STATA command 'melogit' was used in fitting these models. Model comparison was made using the log-likelihood ratio (LLR) and Akaike's Information Criterion (AIC) tests. The model with a small AIC value was selected and all the interpretations and inferences were made based on this model. The random effects were assessed with Intra-Cluster Correlation (ICC) which determined the variation within cluster and between cluster differences. The research sample was weighted (v005/1,000,000), and the Stata survey set (svy) command was used in the analyses to account for the survey's complexity and generalizability.

IV. RESULTS

A. Sociodemographic Characteristics of Reproductive Age Women

More than half of the women had early ANC (57.03%). The result shows that the highest prevalence of early ANC visits was among women aged 25-29 years (59.53%), those with secondary/higher education (69.7%), partners with secondary/higher education (68.92%), cohabiting (59.40%) and not working women (57.71%). Women with one birth (63.97%), women who had exposure to mass media (60.17%), Christian (60.91%), women who do not make healthcare decisions alone (57.21%) and those with not a big problem in getting permission to go had the highest prevalence of early ANC visit. With regards to getting money needed for treatment, distance to the health facility, health insurance coverage, region and sex of household head, the prevalence of early ANC visits was found among women with not a big problem (62.02%), not a big problem (61.03%), covered by health insurance (91.13%), and those in Littoral Region (77.54%), and female household head (59.46%), respectively. The highest prevalence of early ANC visits was found among women who were in the highest wealth index (72.42%), women residing in the urban area (61.24%), women with a high community literacy level (66.87%) and women with a high community socioeconomic status (67.78%) (see Table I).

Bivariate Association between Early ANC Visit and Explanatory Variables

The prevalence of early ANC visits among reproductive-age women in Benin was 57.03%. In the bivariate analysis, age (years) ($p = 0.001$), educational level ($p < 0.001$), partner's educational level ($p < 0.001$), marital status ($p = 0.020$), parity ($p < 0.001$), mass media ($p < 0.001$), religion ($p < 0.001$), getting permission to go ($p < 0.001$), getting the money needed for treatment ($p < 0.001$), distance to health facility ($p < 0.001$), health insurance coverage ($p < 0.001$), region ($p < 0.001$), sex of household head ($p = 0.028$), wealth ($p < 0.001$), type of place of residence ($p < 0.001$), community literacy level ($p < 0.001$), and community socioeconomic status ($p < 0.001$) were statistically associated with early ANC visit among reproductive age women (Table I).

B. Multilevel Logistic Regression Model on Predictors of Early ANC Visits among Women of Reproductive Age in Benin

In Table II, Model 3 presents the results of the multilevel logistic analysis on the predictors of early ANC visits among women of reproductive age in Benin. With regards to age, women aged 30-34 [aOR = 1.60, 95% CI = 1.17-2.18], women with primary educational levels [aOR = 1.22, 95% CI = 1.06-1.42], partners with secondary/higher education [aOR = 1.35, 95% CI = 1.15-1.57], and women covered with health insurance [aOR = 3.03, 95% CI = 1.35-6.76] had higher odds of early ANC visit than their counterparts.

TABLE I
 SOCIODEMOGRAPHIC CHARACTERISTICS OF WOMEN OF REPRODUCTIVE AGE (WEIGHTED, N = 6,919)

Variables	Frequency (N)	Weighted (%)	Early ANC Visit		X ² , p-value
			No (%) 42.97	Yes (%) 57.03	
Individual-level variables					
Age X ² = 23.9853, p = 0.001*					
15-19	327	4.72	44.70	55.30	
20-24	1,439	20.79	41.73	58.27	
25-29	1,968	28.44	40.47	59.53	
30-34	1,465	21.17	42.48	57.52	
35-39	1,074	15.53	45.08	54.92	
40-44	449	6.49	47.80	52.20	
45-49	197	2.85	55.08	44.92	
Education X ² = 155.3257, p < 0.001*					
No education	4,364	63.07	48.46	51.54	
Primary	1,294	18.71	36.75	63.25	
Secondary+	1,261	18.22	30.33	69.67	
Partner's education X ² = 184.4402, p < 0.001*					
No education	3,515	50.80	49.97	50.03	
Primary	1,528	22.09	41.43	58.57	
Secondary+	1,876	27.11	31.08	68.92	
Marital status X ² = 5.3712, p = 0.020*					
Married	5,407	78.14	43.63	56.37	
Cohabitation	1,512	21.86	40.60	59.40	
Employment status X ² = 0.2279, p = 0.633					
Not working	1,092	15.79	42.29	57.71	
Working	5,827	84.21	43.09	56.91	
Parity X ² = 66.3507, p < 0.001*					
One birth	1,242	17.96	36.03	63.97	
Two births	1,298	18.75	38.96	61.04	
Three births	1,178	17.02	41.37	58.63	
Four or more births	3,201	46.27	47.87	52.13	
Mass media X ² = 50.0111, p < 0.001*					
No	2,486	35.93	48.57	51.43	
Yes	4,433	64.07	39.83	60.17	
Religion X ² = 75.2869, p < 0.001*					
Traditional	697	10.08	47.18	52.82	
Islam	2,095	30.28	46.71	53.29	
Christian	3,776	54.58	39.09	60.91	
No religion	351	5.07	53.97	46.03	
Healthcare decision making capacity X ² = 1.0816, p = 0.298					
Alone	677	9.79	44.58	55.42	
Not Alone	6,242	90.21	42.79	57.21	
Getting medical help for self: getting permission to go X ² = 20.8039, p < 0.001*					
Big problem	1,510	21.82	48.62	51.38	
Not a big problem	5,409	78.18	41.39	58.61	
Getting medical help for self: getting money needed for treatment X ² = 58.7808, p < 0.001*					
Big problem	3,663	54.94	47.40	52.60	
Not a big problem	3,256	47.06	37.98	62.02	
Getting medical help for self: distance to health facility X ² = 92.2706, p < 0.001*					
Big problem	2,174	31.42	51.69	48.31	
Not a big problem	4,745	68.58	38.97	61.03	
Health insurance coverage X ² = 34.1405, p < 0.001*					
No	6,852	99.04	43.30	56.70	
yes	67	0.96	8.87	91.13	
Household/community level variables					
Region X ² = 312.3742, p < 0.001*					
Alibori	908	13.12	46.32	53.68	
Atacora	539	7.78	67.06	32.94	

Variables	Frequency (N)	Weighted (%)	Early ANC Visit		X ² , p-value
			No (%) 42.97	Yes (%) 57.03	
Atlantic	812	11.74	31.42	68.58	
Borgou	681	9.84	49.64	50.36	
Collines	514	7.43	35.86	64.14	
Couffo	496	7.17	45.76	54.24	
Donga	466	6.74	54.44	45.56	
Littoral	311	4.50	22.46	77.54	
Mono	337	4.88	35.45	64.55	
Oueme	618	8.93	35.98	64.02	
Plateau	464	6.71	47.42	52.58	
Zou	773	11.17	38.95	61.05	
Sex of household head			X ² = 4.8482, p = 0.028*		
Male	5,939	85.84	43.37	56.63	
Female	980	14.16	40.54	59.46	
Wealth			X ² = 258.0550, p < 0.001*		
Poorest	1,169	16.90	55.53	44.47	
Poorer	1,409	20.36	48.16	51.84	
Middle	1,460	21.10	46.95	53.05	
Richer	1,508	21.80	38.53	61.47	
Richest	1,373	19.84	27.58	72.42	
Place of residence			X ² = 34.4983, p < 0.001*		
Urban	2,742	39.64	38.76	61.24	
Rural	4,177	60.36	45.73	54.27	
Community literacy level			X ² = 138.0071, p < 0.001*		
Low	2,508	36.2	49.79	50.21	
Medium	2,608	37.69	43.21	56.79	
High	1,803	26.07	33.13	66.87	
Community socioeconomic status			X ² = 152.4658, p < 0.001*		
Low	3,072	44.39	49.46	50.54	
Moderate	1,914	27.67	43.40	56.60	
High	1,933	27.94	32.22	67.78	

p-value less than 0.05 indicates statistical significance.

Women without a big problem in getting money needed for treatment [aOR = 1.31, 95% CI = 1.16-1.49], distance to health facility not a big problem [aOR = 1.23, 95% CI = 1.08-1.41], those in the richest wealth index [aOR = 1.87, 95% CI = 1.45-2.42], household with female head [aOR = 1.03, 95% CI = 0.89-1.20], and residing in rural areas [aOR = 1.02, 95% CI = 0.87-1.18] had higher odds of early ANC visits than their counterpart. However, women who are cohabiting [aOR = 0.93, 95% CI = 0.81-1.07], with four or more births [aOR = 0.60, 95% CI = 0.48-0.74], not a big problem getting permission to go [aOR = 0.91, 95% CI = 0.79-1.06], those in Atacora Region [aOR = 0.50, 95% CI = 0.37-0.68], high community literacy level [aOR = 0.92, 95% CI = 0.72-1.14], and those in high community socioeconomic status [aOR = 0.86, 95% CI = 0.67-1.10] had lower odds of early ANC visit.

V. DISCUSSION

The prevalence and predictors of early ANC visits among women of reproductive age in Benin were investigated in this study. According to WHO [12] and other empirical studies [23], [30], early ANC visits should begin in the first trimester since this is one of the most crucial times of pregnancy and would prevent the majority of maternal and newborn mortality,

anemia, malaria, malnutrition, and sexually transmitted infections- to prevent mother-to-child transmission. Despite this recommendation, most women in most LMICs do not follow it, resulting in a low incidence of early ANC visits in many SSA countries [23], [26], [31]. In this study, the prevalence of early initiation of ANC visits was 57.03%. The prevalence from this study is similar to a study conducted in rural southern Ghana [23], however, greater than similar studies conducted in Ethiopia [30], [32], [33], Tanzania [34], [35], South Africa [36], and Papua New Guinea [37]. The finding, on the other hand, is lower than those of other similar studies done in northwest Ethiopia [38] and Nepal [39]. The discrepancies in research findings might be explained by disparities in studied area, distinct sociocultural practices and beliefs, and accessibility and availability of health services in various study regions.

This study found that women's age, educational status, partner's educational status, parity, distance to the health facility, the amount of money needed for treatment, health insurance coverage, region, and wealth index were all significantly associated with the initiation of early ANC visits in Benin.

TABLE II
MULTILEVEL LOGISTIC REGRESSION MODEL ON PREDICTORS OF EARLY ANC VISITS AMONG WOMEN OF REPRODUCTIVE AGE IN BENIN

Variables	Model 0	Model 1 aOR (95% CI)	Model 2 aOR (95% CI)	Model 3 aOR (95% CI)
Fixed effect results				
Individual-level variables				
Age				
15-19		Ref		Ref
20-24		1.34* (1.03-1.76)		1.26 (0.96-1.64)
25-29		1.72*** (1.30-2.30)		1.58** (1.18-2.10)
30-34		1.84*** (1.35-2.50)		1.60** (1.17-2.18)
35-39		1.82*** (1.32-2.50)		1.57** (1.13-2.17)
40-44		1.81*** (1.27-2.59)		1.59* (1.11-2.28)
45-49		1.51 (0.99-2.30)		1.38 (0.90-2.11)
Education				
No education		Ref		Ref
Primary		1.28*** (1.11-1.48)		1.22** (1.06-1.42)
Secondary+		1.29** (1.09-1.52)		1.19 (1.00-1.41)
Partner's education				
No education		Ref		Ref
Primary		1.15* (1.00-1.33)		1.03 (0.89-1.19)
Secondary+		1.56*** (1.34-1.81)		1.35*** (1.15-1.57)
Marital status				
Married		Ref		Ref
Cohabitation		1.03 (0.89-1.18)		0.93 (0.81-1.07)
Parity				
One birth		Ref		Ref
Two births		0.78** (0.65-0.94)		0.77** (0.64-0.93)
Three births		0.72** (0.58-0.88)		0.72** (0.58-0.88)
Four or more births		0.58*** (0.47-0.71)		0.60*** (0.48-0.74)
Mass media				
No		Ref		Ref
Yes		1.20** (1.07-1.34)		1.04 (0.92-1.17)
Religion				
Traditional		Ref		Ref
Islam		0.99 (0.81-1.22)		1.12 (0.88-1.41)
Christian		1.19 (0.99-1.43)		1.09 (0.90-1.32)
No Religion		0.89 (0.67-1.18)		1.06 (0.80-1.42)
Getting medical help for self: getting permission to go				
Big problem		Ref		Ref
Not a big problem		0.91 (0.78-1.05)		0.91 (0.79-1.06)
Getting medical help for self: getting money needed for treatment				
Big problem		Ref		Ref
Not a big problem		1.28*** (1.13-1.45)		1.31*** (1.16-1.49)
Getting medical help for self: distance to health facility				
Big problem		Ref		Ref
Not a big problem		1.32*** (1.16-1.51)		1.23** (1.08-1.41)
Health insurance coverage				
No		Ref		Ref
Yes		3.56*** (1.59-7.97)		3.03** (1.35-6.76)
Household/community-level variables				
Region				
Alibori			Ref	Ref
Atacora			0.48*** (0.36-0.64)	0.50*** (0.37-0.68)
Atlantic			1.56** (1.17-2.08)	1.75*** (1.27-2.42)
Borgou			0.86 (0.66-1.13)	0.90 (0.68-1.18)
Collines			1.45* (1.09-1.93)	1.47* (1.06-1.99)
Couffo			0.99 (0.74-1.33)	0.99 (0.71-1.38)
Donga			0.63** (0.46-0.85)	0.61*** (0.45-0.82)
Littoral			1.56* (1.10-2.22)	1.63* (1.12-2.37)

Variables	Model 0	Model 1 aOR (95% CI)	Model 2 aOR (95% CI)	Model 3 aOR (95% CI)
Mono			1.44* (1.03-2.00)	1.54* (1.07-2.22)
Oueme			1.25 (0.92-1.68)	1.43* (1.04-1.99)
Plateau			0.93 (0.69-1.26)	1.07 (0.77-1.48)
Zou			1.26 (0.95-1.67)	1.34 (0.98-1.83)
Wealth				
Poorest			Ref	Ref
Poorer			1.19* (1.01-1.41)	1.15 (0.97-1.36)
Middle			1.23* (1.03-1.47)	1.12 (0.93-1.33)
Richer			1.70*** (1.41-2.06)	1.46*** (1.20-1.78)
Richest			2.67*** (2.09-3.38)	1.87*** (1.45-2.42)
Sex of household head				
Male			Ref	Ref
Female			1.07 (0.92-1.25)	1.03 (0.89-1.20)
Place of residence				
Urban			Ref	Ref
Rural			1.00 (0.86-1.17)	1.02 (0.87-1.18)
Community literacy level				
Low			Ref	Ref
Medium			1.00 (0.85-1.18)	0.92 (0.78-1.09)
High			1.08 (0.87-1.36)	0.91 (0.72-1.14)
Community socioeconomic status				
Low			Ref	Ref
Moderate			0.93 (0.78-1.10)	0.92 (0.78-1.09)
High			0.87 (0.68-1.12)	0.86 (0.67-1.10)
Random effect results				
PSU variance (95% CI)	0.39 (0.31-0.51)	0.25 (0.18-0.34)	0.15 (0.10-0.23)	0.14 (0.09-0.22)
ICC	0.107	0.068	0.045	0.041
LR Test	$X^2 = 196.25, p < 0.001$	$X^2 = 88.13, p < 0.001$	$X^2 = 44.16, p < 0.001$	$X^2 = 35.57, p < 0.001$
Wald chi-square	Ref	272.12	304.81	422.81
Model fitness				
Log-likelihood	-4627.6964	-4485.8206	-4485.2981	-4414.2438
AIC	9259.393	9019.640	9016.596	8918.488
BIC	9273.077	9183.85	9173.963	9226.379
N	6,919	6,919	6,919	6,919

Source: 2017/2018 BDHS

*p < 0.05, **p < 0.01, ***p < 0.001, aOR adjusted odds ratio

Ref Reference category; PSU Primary Sampling Unit; ICC Intra-Class Correlation; aOR adjusted odds ratio; LR Test Likelihood Ratio Test; BIC Bayesian Information Criterion

This study showed that women aged 25-29 years and above were more likely to initiate early ANC visits than women between the ages of 15 and 19 years. Similarly, findings from other studies revealed that women 25 years and above were more likely to initiate early ANC than younger women (15-19) [36], [40]. This might be because, the younger mothers (15-19 years) may not be financially independent to start early ANC visits, even if they were willing to initiate them [41]. Another probable explanation is that younger women may be concerned about the stigma and ramifications of adolescent pregnancy, which may hinder their education [42]. We concur with a study conducted in SSA [25] that adolescent-friendly ANC visits should be separated to enhance the early initiation of ANC visits among younger women. However, a study conducted in Southern Ethiopia was inconsistent with the finding of this present study which revealed that women below 25 years were more likely to have early initiation of ANC visits [33]. This could be attributed to the fact that women between 15 and 19 years were more informed and convincible to initiate early

ANC visit [33].

This study also found that educational status of women was significantly associated with early ANC visits. The study found that women with at least primary level education were more likely to initiate early ANC visits. This supports the findings of multiple studies showing educated women were more likely to initiate early ANC visits [43]-[47]. The logical explanation is that education has empowered women and promoted awareness, understanding, and the value of early initiation of ANC visits [48]

Consistent with previous studies done in Ghana [49], [50], and Sudan [51], this study identified that the odds of early initiation of ANC visits were more likely among women whose partners had at least primary education. This suggests that a partner's educational attainment is essential for enhancing both the mother's and the unborn child's health as they support and grant permission to their partners to seek prenatal care [49].

This study also found that mothers with four or more children were less likely to begin early ANC visits than women with one

child. This conclusion is consistent with the findings of other research, which found that the number of parities of women had a significant correlation with the initiation of early ANC visits [52]-[55]. These findings suggest that women with a high parity postpone initiating ANC visits, and other studies have found this link in a variety of plausible mechanisms. For example, research in SSA found that women with high parity and previous successful pregnancies may be assumed to be well-experienced and used to the regular care provided during ANC, which may delay the initiation of early ANC [42]. Similarly, research in rural north India [55] found that women who had no difficulties with their prior pregnancy may overlook the need of starting ANC early for their current pregnancies. They also mentioned that mothers with additional children may be caring for these children, delaying the early start of ANC visits [56].

Early initiation of ANC visits is highly related to distance to health facilities and money needed for treatment. In this study, women who had no big problem with the distance to health facilities had a greater likelihood of initiating ANC visits earlier than those who had a major difficulty. The conclusion is consistent with earlier research in Northwest Ethiopia [26], [32], Benin [20], and SSA [25]. This might be because women may have money to afford transportation to and from the health facility.

Several studies in Ghana [57], Liberia [58], South Africa [59], and Indonesia [60] indicated that health insurance coverage was strongly associated with early ANC visits. In this study, women with health insurance had a greater likelihood of initiating ANC visits earlier. One plausible explanation for this outcome is that health insurance coverage may encourage pregnant women to undertake early ANC visits. Another potential rationale is that health insurance coverage would likely lower out-of-pocket expenses and eliminate any financial obstacles to initiating ANC visits earlier.

According to the findings of this study, women from Benin's Atacora region were less likely to begin early ANC visits. The Atacora region, located in northern Benin, is mostly a rural area with a poor road network and a dispersed population, as well as considerable distances to health care services [20]. SSA [20], [61] and Nepal [62] studies demonstrate that regions primarily categorized as rural have poor transportation infrastructure and spatially limited access to health facilities.

Ultimately, the study found that women with the greatest wealth index had a higher likelihood of commencing early ANC visits than women with the lowest wealth index. This is similar with the findings of other LMIC investigations [63]-[65]. The most likely explanation is that financially independent women can afford the expense of ANC and, as a result, begin ANC services earlier.

VI. STRENGTHS AND LIMITATION OF THE STUDY

Notwithstanding the value of the study's findings, the following limitations must be considered. For start, the research design renders a causal interpretation of the data difficult. Second, because the research required women to recall earlier experiences, social desirability and recall biases are plausible. Apart from these factors, the relatively high sample size and use

of a nationally representative dataset may allow the findings to be generalizable to women of reproductive age in Benin. The study also used a variety of approaches to obtain correct data, and the response rate was pretty high throughout data collecting. In addition, a thorough literature search was conducted to account for numerous characteristics linked with early ANC attendance.

VII. CONCLUSION

This study revealed a relatively high incidence of early ANC initiation among women in Benin; women's age, educational status, parity, and wealth index were all associated with early ANC visits. These factors ought to be taken into account when developing new policies or assessing existing policies and strategies for ANC adoption in Benin in order to boost early ANC visits among women. This will significantly reduce maternal and newborn mortality.

DECLARATIONS

Consent for Publication

Not applicable

Ethics Approval and Consent to Participate

Secondary data were used; hence no ethical application was required. Authors requested for the BDHS dataset (<https://www.dhsprogram.com/>) and obtained approval to access and use the dataset. Further information about Benin DHS data usage and ethical standards are available at <https://dhsprogram.com/publications/publication-FR350-DHS-Final-Reports.cfm>.

Availability of Data and Materials

Data are available on https://dhsprogram.com/data/dataset/Benin_Standard-DHS_2017.cfm?flag=1. Other authors would be able to access or request these data in the same manner as we did from DHS program. Authors did not have any special access or request privileges that others would not have.

Competing Interests

The authors declare that there are no competing interests.

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