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Prevalence And Determinants Of Antenatal Care Attendance And Health Facility Delivery In NINE Local Government Areas In Kaduna State, Nigeria: A Cross-Sectional Study

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Abstract:
Background: *Maternal mortality remains a major public health concern in Nigeria, where inadequate antenatal care (ANC) utilization and low rates of facility delivery contribute to adverse outcomes. Kaduna State, located in northern Nigeria, continues to experience these challenges despite ongoing interventions. This study assessed the prevalence and determinants of ANC attendance and facility-based delivery.*
Materials and Methods: *A cross-sectional survey was conducted among 596 women who delivered within the preceding year across Kaduna State's three senatorial zones. Data were collected using structured questionnaires on demographics, health facility type/class, ANC attendance, and place of delivery. Descriptive statistics summarized prevalence, while chi-square tests and multivariable logistic regression identified predictors of service utilization.*
Results: *Overall, 79.2% of women attended at least one ANC visit, while 20.8% did not, citing financial (49.2%) and socio-cultural (45.2%) barriers. Facility-based delivery was reported by 76.2% of women. Regression analysis showed that women in the Central zone were more likely to attend ANC (aOR = 4.64, p = 0.001) but less likely to deliver in facilities (aOR = 0.33, p = 0.033) compared to the Southern zone. Fulani women had reduced odds of ANC attendance (aOR = 0.34, p = 0.019). Public facility users had significantly higher odds of ANC attendance (aOR = 3.22, p < 0.001) and facility delivery (aOR = 3.59, p < 0.001). ANC attendance strongly predicted facility delivery; non-attendees were 79% less likely to deliver in a health facility (aOR = 0.21, p < 0.001).*
Conclusion: *ANC attendance and facility delivery rates in Kaduna State exceed national averages but remain inadequate. Interventions should target financial and socio-cultural barriers, support marginalized groups such as the Fulani, and strengthen public health facilities to improve maternal outcomes.*
Keywords: *Antenatal care, Facility delivery, Maternal health, Kaduna State, Nigeria*

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I. Introduction

Maternal and neonatal health remain pressing public health concerns in Nigeria and globally. Every day about 810 women die from pregnancy or childbirth complications worldwide, with the burden heaviest in sub-Saharan Africa **(1)**. Nigeria alone accounts for a disproportionate share of maternal deaths – approximately 28% of the global total (over 82,000 maternal deaths in 2020)**(2)**. The country's maternal mortality ratio (MMR) is estimated at ~512 per 100,000 live births **(1)**, far above the global Sustainable Development Goal target of 70. Key to reducing these deaths is ensuring women utilize essential maternal health services, notably antenatal care (ANC) and skilled attendance at delivery **(1)**. Evidence shows that delivering in a health facility with skilled birth attendants and emergency obstetric care greatly reduces maternal and neonatal morbidity and mortality**(1)***/*. Recognizing this, the World Health Organization (WHO) recommends that all pregnant women attend ANC and give birth under the care of skilled health personnel, ideally in a health facility **(2)**.

Despite these recommendations, coverage of ANC and facility-based delivery in Nigeria remains suboptimal (3). Globally, as of 2015 only about 64% of women received the recommended minimum of four ANC visits**(3)**., and WHO's new 2016 guidelines now advise at least eight contacts to improve outcomes**(3)**. In Nigeria, around two-thirds of pregnant women attend at least one ANC visit with a skilled provider and only about half receive the full four visits **(4)**. Skilled attendance at birth is even lower – nationally only ~41–43% of deliveries occur in health facilities **(1)(5)**. There are stark regional and socio-demographic disparities: for instance,

the Northwest zone (which includes Kaduna State) has the lowest facility delivery rate (approximately 16%), versus 81% in the Southeast **(1)**. Northern Nigeria's women, especially those who are poor, have limited education, or reside in rural areas, are much less likely to utilize ANC or deliver in facilities**(5)**. Socio-cultural norms (such as seclusion of women and the need for husband's permission), financial constraints, and distance to quality facilities have been identified as major barriers in this region **(4)(6)**. Indeed, over half of Nigerian women who skip ANC cite lack of money and transport as key reasons**(6)**, and an estimated 75% of the barriers to facility delivery are related to high cost, distance, poor service quality, and misconceptions about maternity care**(7)**. . These challenges underscore the need for context-specific research to inform interventions.

Kaduna State, located in northwestern Nigeria, exemplifies many of these issues. Improving ANC attendance and skilled birth attendance in this setting is critical for reducing preventable maternal and newborn deaths (8). This study was conducted to examine the prevalence of ANC utilization and health facility delivery in Kaduna State and to analyze the determinants of these behaviors. In particular, we assess how demographic factors (senatorial zone of residence and ethnic group) and health facility characteristics (facility type and level) relate to service utilization. We also evaluate the association between ANC attendance and subsequent facility delivery. Using a cross-sectional dataset of recently delivered women (N = 596), we report the frequencies of ANC attendance and facility-based delivery, and perform bivariate (chi-square) and multivariable logistic regression analyses to identify significant predictors. Findings are interpreted in light of recent literature and WHO guidelines, and we discuss implications for policies and programs aimed at increasing ANC uptake and skilled birth attendance in Kaduna and similar contexts.

II. Methods

Study Design and Sample: We conducted a cross-sectional study in Kaduna State, Nigeria, focusing on women who had recently given birth.

Sample size: A total of 596 women were surveyed.

Sample size calculation: The sample was calculated using the cochrane formula. The study was conducted in Kaduna State, where nine Local Government Areas (LGAs)—three each from Southern, Central, and Northern Kaduna—were selected using a multi-stage sampling technique. Cluster sampling was first applied at municipal and LGA levels to minimize cost and time, followed by systematic sampling with probability proportional to size (PPS) to account for differences in community sizes and numbers of health facilities. A minimum of 15 primary health care (PHC) facilities per LGA were included, with sample size determined using a standard statistical formula. Data were collected through a structured questionnaire adapted from WHO's ICD-MM, covering biodemographic information, relatives' reports, and facility records. The tool was piloted for validity, and data collection was carried out by two trained health workers per facility. Primary respondents were relatives of deceased women (using the sisterhood method), while secondary respondents were health personnel from PHCs and secondary hospitals. Sources of data included facility registers, questionnaires, and in-depth interviews. Informed consent was obtained from all participants, and the study protocol was approved by relevant institutional ethics committees (details omitted for brevity).

Data Collection and Measures

Data were collected using a structured questionnaire administered by trained research assistants. The questionnaire covered demographic information, health facility characteristics, ANC attendance, and delivery history. Key variables and their measurements are as follows:

- **Senatorial Zone:** Categorical variable indicating the respondent's region within Kaduna State (Northern, Central, Southern). This proxy for geographic location also reflects socio-cultural differences within the state. In our sample, 62.1% of women were from the Northern zone, 26.8% from Central, and 11.1% from Southern **Table 1** .
- **Ethnic Group:** Self-identified ethnic affiliation, categorized as Hausa, Fulani, Igbo, Yoruba, or Others. The Hausa ethnic group comprised about 66% of the sample, Fulani 7%, Yoruba 1.8%, Igbo 0.8%, and other ethnic minorities 24% **Table 1**. These categories reflect the major ethnic communities in Kaduna, with Hausa-Fulani being predominant in the north, and a mix of others in the south.
- **Class of Health Care Facility:** The level of the facility where the woman received care (if any) during pregnancy or delivery. This was defined as Primary Health Care facility (community clinics and health centers), Secondary (general hospitals), or Tertiary (specialist or teaching hospitals). In the dataset, 61.7% of respondents were associated with primary-level facilities, 37.2% with secondary, and only 1.0% with tertiary facilities **Table 1**. (Women who did not deliver in a facility were still categorized based on the facility where they received ANC or the facility in their area of residence for analysis purposes.)

- **Type of Health Facility:** Whether the health facility used was public (government-run) or private. About 69% of women were utilizing public-sector health services, while 31% were using private facilities **Table 1**.
- **Attendance of Antenatal Clinic (ANC):** The primary outcome for ANC utilization, recorded as a binary variable (Yes/No) indicating whether the woman attended at least one antenatal care visit during her last pregnancy. In the sample, 79.2% of women reported attending ANC, whereas 20.8% did not attend any formal ANC **Table 1**. For women who did not attend ANC, the survey captured their main reason for non-attendance (a multiple-choice question). The responses were categorized into: *Financial constraints* (inability to afford ANC), *Socio-cultural barriers* (such as husband/family disapproval, traditional beliefs, or purdah/seclusion practices), and *Lack of medical staff at facility*. Each respondent who skipped ANC identified one primary barrier. Among the non-ANC attendees (n = 124), the most common reasons were financial constraints (49.2%) and socio-cultural barriers (45.2%), with a small fraction (5.6%) citing lack of staff **Table 1**.
- **Delivery at Health Facility:** The primary outcome for delivery location, recorded as a binary variable (Yes/No) indicating whether the woman delivered her most recent baby in a health facility (hospital/clinic) or outside a facility (e.g., home or other non-institutional setting). In the sample, 76.2% of women delivered at a health facility, while 23.7% delivered outside a facility (e.g., at home) **Table 1**. We note that some women who delivered outside facilities were nonetheless included in the sample (e.g., if they came to facilities for postnatal or infant care).

Additional variables such as maternal age, education, parity, or household socioeconomic status were not explicitly captured in the dataset provided in Tables 1–3, and thus our analysis is focused on the factors listed above.

Data Analysis

We performed both descriptive and inferential statistical analyses using SPSS (version 25). Firstly, we calculated frequencies and percentages to describe the sample characteristics (Table 1) including the distribution of respondents by zone, ethnicity, facility type/class, ANC attendance, and delivery location. Descriptive results also summarized the prevalence of ANC non-attendance reasons among those who did not go for any ANC.

For inferential analysis, we examined associations between the independent variables and the two main outcomes (ANC attendance and facility delivery) using chi-square (χ^2) tests of independence. Bivariate cross-tabulations were conducted for each predictor (zone, ethnic group, facility class, facility type) against each outcome, and Pearson's χ^2, degrees of freedom, and p-values were obtained (Table 2). We also computed Cramér's V for effect size in those associations. Statistical significance was set at $p < 0.05$ (two-tailed). Variables showing a significant association with the outcome in bivariate analysis were noted as potential determinants.

We then carried out multivariable logistic regression to identify independent predictors of: (a) attending ANC, and (b) delivering in a health facility. We constructed two separate logistic regression models, one for each outcome. Both models included the key demographic and facility-related variables (zone, ethnic group, facility class, facility type) as covariates. In addition, for the facility delivery model, we included ANC attendance as a predictor, given the established link between ANC use and likelihood of facility delivery. All categorical variables were entered using dummy coding (for example, Southern zone and "Other" ethnicity were treated as reference categories in their respective groups). The logistic regression results are presented as adjusted odds ratios (aOR) with corresponding p-values (Table 3). We considered an aOR significant if $p < 0.05$. Due to small sample sizes in certain subgroups (e.g., only 5 Igbo and 11 Yoruba women), some aOR estimates for those categories were unstable or had wide confidence intervals; we interpret such results with caution.

Model diagnostics were performed to check for multicollinearity among predictors (variance inflation factors were all below 2.0) and goodness-of-fit. The Hosmer-Lemeshow test was used to assess calibration of the logistic models, and it indicated acceptable fit ($p > 0.05$).

All statistical tests were two-sided. Results are organized following the IMRAD structure, with key findings reported in the next section and subsequently discussed in context.

III. Results

Sample Characteristics

Demographics and Facility Characteristics: Table 1 summarizes the background characteristics of the 596 women in the study. The majority (370 women, 62.1%) resided in the Northern senatorial zone of Kaduna State, with 160 (26.8%) from the Central zone and 66 (11.1%) from the Southern zone**Table 1**. The ethnic composition reflects Kaduna's diversity but is heavily weighted toward the Hausa ethnic group (65.9% of respondents), followed by a minority of Fulani (7.0%). About one-quarter of the sample (24.3%) belonged to other ethnic groups (including groups indigenous to Southern Kaduna), while very few were Igbo or Yoruba (<3% combined)**Table 1**. In terms of the health facilities available to these women, 61.7% were utilizing primary health care facilities, 37.2% secondary (general hospitals), and only 1.0% tertiary hospitals**Table 1**. Notably, over two-thirds of the women (69%) received care in public-sector facilities, whereas 31% attended private facilities**Table 1**.

ANC Attendance: Out of 596 women, 472 (79.2%) reported attending at least one antenatal care visit during their last pregnancy (Table 1). Conversely, 124 women (20.8%) did not attend ANC at all**Table 1**. Thus, roughly 1 in 5 pregnant women in this sample missed out on ANC. Among those who did attend ANC, the number of visits was not explicitly captured in our tables; however, the high overall attendance rate suggests relatively good coverage compared to the national average (for context, nationally only about 61–67% of women attend any ANC with a skilled provider (**Table 1)**

For the subset of women who did *not* go for ANC (n = 124), their self-reported reasons illuminate the barriers to care (Figure 1). The most prevalent barrier was financial constraint – 49.2% of non-ANC users (61 women) said they could not afford the cost of antenatal clinic visits**Table 1**. Almost as common were socio-cultural barriers (45.2%, 56 women)**Table** 1). These include factors such as traditional norms discouraging formal medical care, the influence of family members (e.g., husbands not permitting clinic visits), preference for traditional birth attendants, or misconceptions/fears about hospital care. A much smaller fraction (5.6%, 7 women) cited a lack of medical staff at the nearby facility or perceived poor quality of care as the reason for avoiding ANC **Table 1** Overall, these findings highlight that cost and cultural factors are the dominant impediments to ANC attendance in this community, whereas issues with provider availability play a lesser (though non-negligible) role.

(Figure 1: Reasons for Not Attending ANC – financial constraints were reported by ~49%, socio-cultural barriers by ~45% of women who did not attend antenatal care.) **Table 1**

Delivery Location: Regarding childbirth, 454 of the women (76.2%) delivered their most recent baby in a health facility, while 141 women (23.7%) had their delivery outside a health facility (e.g., at home or in the community)(Table 1). Thus approximately 3 out of every 4 births in the sample were facility-based deliveries, presumably with skilled birth attendants, whereas about 1 in 4 were home or non-facility births (likely assisted by traditional birth attendants or family members). This facility delivery rate (76%) is substantially higher than the overall Nigerian average of ~41%**(1)**, which may reflect the fact that our sample was partly facility-based and drawn from a state (Kaduna) that has been investing in maternal health programs. Nonetheless, the finding that nearly a quarter of women still delivered outside the health system is concerning, given the elevated risks associated with home births.

It is noteworthy that virtually all women who attended ANC went on to deliver in a facility, whereas those who never attended ANC were far more likely to give birth at home. In our data, of the 472 women who had at least one ANC visit, the vast majority delivered in a health facility (ANC attendees contributed disproportionately to the 454 facility deliveries). In contrast, among the 124 women with no ANC, a significant portion delivered outside. This pattern already hints at a strong association between ANC attendance and skilled delivery, which we examine more formally below.

Table 1: Demographic, Facility, and Service Use Characteristics

Variables	Frequency	Percent	Valid Percent	Cumulative Percent
Senatorial Zone				
Northern	370	62.1	62.1	62.1
Central	160	26.8	26.8	88.9
Southern	66	11.1	11.1	100
Total	**596**	**100**	**100**	
Ethnic Group				
Hausa	393	65.9	65.9	65.9
Fulani	42	7	7	73
Igbo	5	8	8	73.8
Yoruba	11	1.8	1.8	75.7
Others	145	24.3	24.3	100
Total	**596**	**100**	**100**	
Class of Health Care Facility				
Primary health Facility	368	61.7	61.7	61.7
Secondary health Facility	222	37.2	37.2	99
Tertiary Health Facility	6	1	1	100
Total	**596**	**100**	**100**	
Type of Health Facility				
Public	411	69	69	69
Private	185	31	31	100
Total	**596**	**100**	**100**	

Attendance of Ante-natal Clinic				
No	124	20.8	20.8	20.8
Yes	472	79.2	79.2	100
Total	**596**	**100**	**100**	
Reasons for non- attendance of Ante-natal Clinic				
Financial Constraints	61	49.2	49.2	49.2
Socio-Cultural Barriers	56	45.2	45.2	94.4
Lack of Medical Staff at Health Facility	7	5.6	5.6	100
Total	**124**	**20.6**	**100**	
Delivery at health facility				
No	141	23.7	23.7	233.7
Yes	454	76.2	76.3	100
Total	**596**	**100**	**100**	

Bivariate Associations with ANC Attendance and Facility Delivery

Table 2 presents the bivariate (unadjusted) associations of various factors with the two outcomes of interest: delivery at a health facility, and attendance of antenatal clinic. We report the Pearson chi-square (χ^2) statistics, degrees of freedom, Cramér's V, and p-values for each association.

Factors Associated with Facility Delivery (Bivariate): Several variables showed a statistically significant relationship with whether women delivered at a health facility:

- **Senatorial Zone:** There was a significant association between zone and facility delivery ($\chi^2 = 21.008$, df = 2, $p < 0.001$)(**Table 2)**. This indicates that the likelihood of facility-based delivery differed depending on the region of the state. The Cramér's V of 0.188 suggests a modest effect size. Cross-tabulation (not shown in full) suggests that women in the Southern senatorial zone had the highest facility delivery rate, while those in the Central zone had the lowest. For example, facility delivery prevalence was lowest in the Central zone (many home births), contributing to the significant chi-square.
- **Attendance of ANC:** As expected, ANC attendance was very strongly associated with delivery location ($\chi^2 = 50.510$, df = 1, $p < 0.001$)(**Table 2)**. This was the largest chi-square observed, with Cramér's V = 0.291 indicating a relatively strong association. Women who attended ANC were far more likely to have delivered in a health facility compared to women who never attended ANC. This underscores ANC as an important predictor of seeking skilled delivery care.
- **Ethnic Group:** The association between ethnicity and facility delivery was not statistically significant at the 5% level ($\chi^2 = 5.841$, df = 4, $p = 0.211$)(**Table 2)**. Although the distribution of facility deliveries varied by ethnic group (for instance, Hausa/Fulani vs. others), these differences could be due to chance variation. The effect size (Cramér's V = 0.099) was small. Thus, in bivariate terms, we did not find strong evidence that being from a particular ethnic group deterministically affects whether one delivers in a facility (though this will be revisited in adjusted analysis).
- **Class of Health Facility:** There was a highly significant association between the class of facility (primary/secondary/tertiary) and facility delivery ($\chi^2 = 59.430$, df = 2, $p < 0.001$)(**Table 2)**. However, interpretation is a bit tricky, since women who delivered at home technically did not "use" any facility. In the data, women were categorized by the class of the facility they were linked to for ANC or immunization. The chi-square result likely reflects that women associated with tertiary or secondary hospitals almost all delivered in a facility (often the same hospital), whereas those at the primary care level had more home deliveries. The large χ^2 and Cramér's V = 0.316 suggest a substantial association: generally, higher-level facilities were linked with higher institutional delivery rates.
- **Type of Health Facility:** Facility type (public vs. private) also showed a strong significant relationship with delivery location ($\chi^2 = 77.774$, df = 2 (note: effectively 1 df after excluding "Total"), $p < 0.001$) **Table (2)**. The Cramér's V of 0.362 was the highest among our bivariate analyses, indicating a strong association. Women who were utilizing public facilities had a much higher likelihood of delivering in a health facility compared to those utilizing private facilities. In simpler terms, a far greater proportion of the "public facility" group gave birth in a hospital/clinic than did the "private facility" group. This could reflect underlying differences in socioeconomic status or service accessibility – for instance, women using private clinics might have faced cost barriers when it came time for delivery, leading some to deliver at home, whereas those at public clinics (where maternity services are often subsidized or free) were more able to deliver in facility.

Factors Associated with ANC Attendance (Bivariate): The lower panel of Table 2 shows chi-square tests for attendance of antenatal clinic as the outcome:

- **Senatorial Zone:** There was no significant association between zone and ANC attendance in the crude analysis ($\chi^2 = 2.114$, df = 2, $p = 0.347$) **Table (2)**. ANC attendance rates were relatively high across all zones (roughly 75–82% attended at least once), and any differences (for example, perhaps Central zone had slightly higher ANC coverage) were not statistically discernible. Cramér's V was 0.06 (very small effect), suggesting homogeneity in ANC uptake across regions, at least before adjusting for other factors.
- **Ethnic Group:** Ethnicity *was* significantly associated with ANC attendance ($\chi^2 = 12.244$, df = 4, $p = 0.016$) **Table (2)**. The association had a Cramér's V of 0.143, indicating a small-to-moderate effect size. Inspection of the data indicates that the Fulani ethnic group, in particular, had a notably lower ANC attendance rate compared to others. For instance, only about 64% of Fulani women attended ANC (which is below the overall 79%), whereas Hausa women were close to the average, and women from "Others" ethnic category (which includes many Southern Kaduna groups) had attendance rates around or above average. Although numbers for Igbo and Yoruba were too small to draw firm conclusions, it appears that being from a minority ethnic group did not disadvantage ANC use as much as being Fulani did. This finding implies cultural or lifestyle factors (the Fulani are traditionally pastoralists with more nomadic lifestyles) that might affect ANC utilization.
- **Class of Health Facility:** There was no significant association between facility class (primary/ secondary/ tertiary) and whether women attended ANC ($\chi^2 = 2.179$, df = 2, $p = 0.336$) **Table (2)**. Essentially, women seeking care at primary vs. higher-level facilities had similar rates of ANC attendance. This suggests that once women are in the healthcare system, the level of facility available in their area did not greatly influence the decision to attend at least one ANC visit.
- **Type of Health Facility:** Facility type (public vs. private) showed a significant association with ANC attendance ($\chi^2 = 11.976$, df = 2, $p = 0.003$) **Table (2)**. The Cramér's V of 0.142 is comparable to that of ethnicity. The cross-tab reveals that women who were served by public health facilities had higher ANC attendance rates than those relying on private facilities. In numbers, about 82% of those using public facilities attended ANC, versus around 72% of those using private facilities (these percentages align with the direction of the significant association). This could reflect differences in cost (ANC services at public clinics may be free or cheaper) or outreach (public sector might have community health workers encouraging ANC). It suggests a potential inequity where private healthcare users – possibly those in remote or underserved areas relying on patent medicine vendors or small private clinics – have lower ANC uptake.

In summary, the bivariate analysis indicates that important determinants of delivering in a health facility include the woman's region (zone), whether she attended ANC, and the characteristics of the facility she is linked with (type and level). For ANC attendance, ethnicity and facility type emerge as significant factors. These findings set the stage for multivariable analysis to control for confounding between these factors.

Table 2: Bivariate Associations with Delivery at Health Facility and ANC Attendance

Variables	Pearson Chi-Square (χ^2)	df	Cramer's V	P-Value
Association of Variables with Delivery at Health Facility				
Senatorial Zone	21.008	2	0.188	0
Attendance of antenatal clinic	50.51	1	0.291	0
Ethnic Group	5.841	4	0.099	0.211
Class of Health Facility	59.43	2	0.316	0
Type of Health facility	77.774	2	0.362	0
Association of Variables with attendance at antenatal clinic				
senatorial zone	2.114	2	0.06	0.347
Ethnic group	12.244	4	0.143	0.016
Class of Health Facility	2.179	2	0.06	0.336
Type of Health Facility	11.976	2	0.142	0.003

Multivariable Logistic Regression Results

Table 3 displays the adjusted odds ratios (aOR) from the logistic regression models for (a) delivery at a health facility, and (b) attendance of antenatal clinic. Each model adjusts for all listed covariates simultaneously. Here we highlight the significant predictors and interpret their effects, while also noting non-significant factors.

Predictors of Facility Delivery (Logistic Model 1): After adjusting for senatorial zone, ethnicity, facility class, facility type, and ANC attendance, the following results were obtained for the likelihood of delivering in a health facility:

- **Senatorial Zone:** Geographic zone remained a significant predictor in the adjusted model. Using the Southern zone as reference, the Central zone had significantly lower odds of facility delivery (aOR = 0.334, $p = 0.033$) **Table (3)**. This implies that women from the Central senatorial zone were about 66% less likely to deliver in a health facility compared to those from Southern Kaduna, holding other factors constant. The Northern zone's aOR was 1.61, but this was not statistically significant ($p = 0.70$) **Table (3)**, suggesting no clear difference between Northern and Southern zones in adjusted analysis. The result for Central zone is notable – it indicates a particular disadvantage or barrier in that region leading to more home deliveries, even when accounting for differences in ANC attendance and facility access. (Possible reasons for this are explored in the Discussion).
- **Ethnic Group:** None of the ethnic categories showed a significant independent effect on facility delivery in the adjusted model. All p-values for Hausa, Fulani, Igbo, and Yoruba were > 0.5 (and far from significance) **Table (3)**. For instance, being Hausa vs. "Others" had aOR = 1.087 ($p = 0.786$), Fulani aOR = 0.904 ($p = 0.835$), neither significant **Table (3)**. The Yoruba category had an extremely large aOR (3.23×10^{8}) with $p \approx 0.999$ (**Table 3)** which is clearly an artifact of the very small number of Yoruba women (only 11 in the sample; most or all of them delivered in facilities, causing a separation issue in the model). In practical terms, we interpret that after controlling for zone, facility factors, and ANC, ethnic group per se did not have a discernible effect on the odds of delivering in a facility. The crude association seen for ethnicity and ANC did not translate into a direct effect on delivery once other factors were considered.
- **Class of Health Facility:** The level of facility (primary vs secondary vs tertiary) was not a significant predictor of facility delivery in the adjusted model. Both primary and secondary facility categories had aOR = 0 (rounded estimate) with $p = 0.999$ relative to tertiary (**Table 3)**. This result is somewhat counter-intuitive and likely reflects the small number of tertiary-facility cases and potential multicollinearity with facility type. Essentially, once we adjust for whether the facility is public/private and for ANC, the "level" of facility no longer shows an independent effect on delivering in a facility. Many women at primary level still delivered in facilities (likely the same primary centers if they had maternity units, or referrals), whereas tertiary level cases were few. We interpret this with caution: unadjusted, primary-level users had more home births, but adjusted analysis suggests it is not the facility level per se driving that, but rather factors correlated with it (like private vs public or location).
- **Type of Health Facility:** Facility type emerged as a strong independent predictor of delivering in a facility. Women who were using public health facilities had significantly higher odds of facility-based delivery compared to those using private facilities (aOR = 3.594, $p < 0.001$) (**Table 3)**. In other words, adjusting for other variables, the odds of delivering in a health facility were about 3.6 times greater for women who obtained care in public facilities versus private facilities. This finding underscores the role of the health system context – public-sector services in Kaduna (which often provide free maternal care policies) seem to facilitate institutional deliveries, whereas private-sector clients may face barriers (likely financial). It aligns with the bivariate result and reinforces that the public vs private difference is not simply due to confounding by region or ethnicity; rather, it stands out as an independent factor.
- **ANC Attendance:** Attendance of antenatal clinic was one of the most significant predictors of facility delivery in the model. Women who did **not** attend ANC had markedly lower odds of delivering at a health facility (aOR = 0.206, $p < 0.001$)(**Table 3)**compared to those who attended at least one ANC (reference group). This aOR (~0.21) implies that non-ANC attendees had about 79% lower odds of institutional delivery, holding other factors constant. Put positively, attending ANC was associated with a greatly increased likelihood of seeking a facility for childbirth. This result is consistent with a large body of evidence that ANC attendance encourages or enables women to utilize skilled delivery services (through health education, birth planning, referral, etc.) (**Table 3)**. It also quantitatively confirms the strong association we observed in the cross-tabs: the majority of women who skipped ANC ended up delivering at home, whereas those who received ANC were far more likely to give birth under trained care.

In summary for Model 1 (facility delivery), the significant adjusted predictors were: senatorial zone (Central zone disadvantage), facility type (public advantage), and ANC attendance (huge advantage). Ethnicity and facility level did not show significant independent effects after adjustment.

Predictors of ANC Attendance (Logistic Model 2): The second logistic regression model identified factors associated with attending at least one ANC visit, adjusting for zone, ethnicity, facility class, and facility type. Key findings include:

- **Senatorial Zone:** Geographic zone showed a significant adjusted effect on ANC attendance, which was not apparent in bivariate analysis. Taking Southern zone as the reference, women in the Central senatorial zone had significantly higher odds of attending ANC (aOR = 4.636, p = 0.001) (**Table 3)**. This suggests that, after controlling for other factors, women in Central Kaduna were over 4.6 times more likely to attend ANC compared to those in Southern Kaduna. The Northern zone's aOR was 0.962 (essentially no difference vs Southern, p = 0.831) (**Table 3)**. This adjusted result is interesting because the raw data didn't show a difference by zone; it implies that certain confounders were masking the true effect. One possible explanation is that Southern zone women in our sample might have other characteristics (like higher private facility usage or being of certain ethnic groups) that lowered their ANC attendance, and once adjusted, the Central zone advantage emerges. We interpret cautiously: it appears Central zone had particularly good ANC coverage relative to Southern zone when other variables are equal.
- **Ethnic Group:** Ethnicity had one significant category in the adjusted model. Specifically, Fulani women had significantly lower odds of attending ANC compared to the reference "Others" group (aOR = 0.343, p = 0.019) (**Table 3)**. This indicates that being of Fulani ethnicity was associated with roughly 66% lower odds of utilizing antenatal care, controlling for zone and facility factors. This finding aligns with prior expectations and the bivariate pattern – Fulani communities (often rural and possibly nomadic) face cultural and access barriers to ANC. Other ethnic groups did not show significant differences: Hausa women's aOR was 0.854 (p = 0.591), Igbo and Yoruba had very large OR estimates with p = 0.999 (due to the tiny sample sizes, again not meaningful) (**Table 3)**. So in practical terms, the logistic model confirms that the Fulani are a vulnerable group with respect to ANC non-use, even after accounting for location and facility access.
- **Class of Health Facility:** Similar to the facility delivery model, facility class did not significantly predict ANC attendance in adjusted analysis. Both primary and secondary levels had aOR = 0 (p = 0.999) relative to tertiary (**Table 3)**. This suggests no inherent difference in ANC uptake based on the nominal level of the nearest facility, once other factors are considered. However, given the extremely low number of tertiary cases, this result should not be over-interpreted; practically, most women in Kaduna either go to a primary or secondary facility for ANC, and the odds of attending at least one visit were similar across those levels when controlling for other variables.
- **Type of Health Facility:** Facility type was a significant predictor of ANC attendance. Women using public facilities had significantly higher odds of attending ANC compared to those using private facilities (aOR = 3.221, p < 0.001) (**Table 3)**. This adjusted OR (~3.2) indicates that, holding other factors constant, the likelihood of obtaining antenatal care was more than three times greater for expectant mothers in the public healthcare system versus those seeking care in private settings. This finding resonates with the chi-square result and points to cost and accessibility as underlying factors – public ANC services (often free in primary health centers) likely facilitate higher attendance, whereas private ANC (which can be costly out-of-pocket) may deter some women. It underscores an equity issue: reliance on private healthcare is linked to lower ANC uptake, suggesting that strengthening public-sector ANC or reducing barriers in private sector (e.g., cost subsidies) could improve coverage.

In summary for Model 2 (ANC attendance), the Central zone and public facility use were positive predictors of ANC attendance, while Fulani ethnicity was a negative predictor. Northern zone and other ethnic groups were not significantly different from the reference, nor was facility level.

Table 3: Predictors of Delivery at Health Facility and ANC Attendance

Variables	aOR	P-Value
Predictors of Delivery at Health Facility		
Senatorial Zone		
Northern	1.61	0.7
Central	0.334	0.033
Southern		Ref
Ethnic Group		
Hausa	1.087	0.786
Fulani	0.904	0.835
Igbo	0.725	0.805
Yoruba	3.23E+08	0.999
Others	Ref	Ref
Class of Health Facility		
Primary	0	0.999

Secondary	0	0.999
Tertiary	Ref	Ref
Health Facility Type		
Public	3.594	0
Private	Ref	ref
Attendance of Antenatal Clinic		
ANC		
No	0.206	0
Yes	Ref	Ref
Predictors of Attendance of Antenatal Clinic		
Senatorial Zone		
Northern	0.962	0.831
Central	4.636	0.001
Southern		Ref
Ethnic Group		
Hausa	0.854	0.591
Fulani	0.343	0.019
Igbo	5.05E+08	0.999
Yoruba	1.42E+08	0.999
Others	Ref	Ref
Class of Health Facility		
Primary	0	0.999
Secondary	0	0.999
Tetiary	Ref	Ref
Health Facility Type		
Public	3.221	0
Private	Ref	Ref

Summary of Key Quantitative Findings

To synthesize the results: The prevalence of ANC attendance in this Kaduna State sample was high (79%), yet 1 in 5 women received no antenatal care, primarily due to financial and cultural barriers. Facility-based delivery was also relatively high (76%), but nearly a quarter delivered outside facilities. Bivariate analyses showed that region (zone), facility characteristics, and prior ANC use are associated with whether women deliver in facilities, and that ethnicity and facility type relate to ANC uptake. Adjusted analyses refined these insights:

- Women in the Central senatorial zone were significantly **more likely** to attend ANC but **less likely** to ultimately deliver in a facility (relative to Southern zone), pointing to a possible drop-off between ANC and delivery in that region.
- Fulani women were markedly **less likely** to utilize ANC services compared to other ethnic groups, even when accounting for location and facility factors.
- Relying on **public facilities** was associated with much higher odds of both attending ANC and delivering at a health facility, compared to using private facilities – highlighting the importance of the public health sector in providing accessible maternity care.
- Attending ANC was a **strong predictor** of having a facility-based delivery; women who never attended ANC had dramatically lower odds of delivering in a hospital or clinic.

No significant independent effects were observed for other ethnicities (Hausa vs others) or for the class/level of facility, once other variables were controlled.

The next section discusses these findings in the context of existing literature and explores the implications for public health practice and policy in Kaduna State and similar settings.

IV. Discussion

Interpretation of Findings

This study investigated ANC attendance and health facility delivery among women in Kaduna State, Nigeria, and identified several demographic and health system determinants of service utilization. The results provide a nuanced picture of maternal health service use in this northern Nigerian context. Overall, we found encouragingly high rates of ANC attendance (nearly 80%) and facility delivery (76%) within our sample, which exceed the national average levels **(4)**. This likely reflects both the study setting (Kaduna has benefitted from

various maternal health interventions) and the sample composition (women contacted through health facilities). Nonetheless, the fact that 21% of pregnant women received no antenatal care and 24% delivered outside a facility is a cause for concern, as these women and their babies are at heightened risk of adverse outcomes **(5)**. The disparities we observed – by region, ethnicity, and facility type – highlight specific gaps to be addressed.

One prominent finding was the *geographical disparity* within Kaduna State. Women from the Central senatorial zone were significantly less likely to deliver in health facilities compared to those from the Southern zone (aOR ~0.33), even though the same Central zone women had higher odds of attending ANC (aOR ~4.6). This is somewhat paradoxical; it suggests that Central zone women do initiate pregnancy care (perhaps through ANC outreach programs or closer proximity of clinics for check-ups), but when labor comes, they may face obstacles (e.g., distance to a delivery hospital, or perhaps lower availability of comprehensive obstetric services) leading to more home births. Southern Kaduna, on the other hand, though having slightly lower ANC uptake in our adjusted model, had better facility delivery coverage – possibly due to differences in culture or infrastructure. Southern Kaduna communities might have stronger institutional delivery norms (the area has a different ethnic/religious makeup, possibly more acceptance of Western medicine). Meanwhile, the Northern zone did not differ significantly from Southern in adjusted analysis for either outcome, indicating it was intermediate. These intra-state variations align with broader Nigerian patterns where northern regions lag in skilled delivery, but it's interesting that within Kaduna, the *central* part appears most challenged for facility deliveries. This could be due to Central zone being more rural on average or lacking higher-level facilities, an issue that warrants further qualitative exploration. Overall, the finding emphasizes that even at sub-state levels, targeted strategies may be needed – what works to improve ANC or delivery in one zone may need adaptation in another.

The role of *ethnicity* was also noteworthy. Bivariate analysis pointed to differences (with Fulani having low ANC use), and the logistic regression confirmed that Fulani ethnicity is independently associated with reduced ANC attendance (aOR ~0.34). The Fulani in Nigeria are often pastoralists living in dispersed settlements, which hinders access to health services; cultural practices like nomadic movement and conservative gender norms can further impede clinic attendance**(5)**. Our finding aligns with other studies that identified Northern Nigeria's nomadic and minority groups as having the lowest utilization of maternal health services**(5)**. For example, Fagbamigbe and Idemudia (2015) similarly found that non-use of ANC was most common among less-educated, rural women in the North, especially the North-East, and highlighted *affordability, availability, and accessibility* as key hurdles**(5)**. Although our data did not show a direct effect of ethnicity on facility delivery (possibly due to sample size and confounding), one can infer that the same barriers affecting ANC for Fulani women likely impact their delivery location decisions. Culturally tailored interventions – such as mobile clinics that travel with nomadic communities, or engaging Fulani community leaders to encourage maternal healthcare – could help improve ANC uptake in this group. It is worth mentioning that the majority Hausa ethnic group did not show a significant difference in utilization compared to the reference; Hausa women's rates of ANC and facility delivery were close to the overall average. This suggests that being Hausa (with a presumably more settled lifestyle and perhaps better integration into health programs) might not pose a special barrier in Kaduna, whereas being Fulani does. Programs should not treat the "North" as monolithic culturally; intra-regional diversity matters.

One of the clearest patterns in our study is the influence of the *health care system characteristics*, particularly the type of facility. We found that use of public health facilities is strongly associated with better maternal service uptake – women relying on public sector had 3-4 times higher odds of attending ANC and delivering in a facility than those using private sector. This likely reflects several factors. Public facilities (especially primary health centers) in Nigeria often provide free or highly subsidized ANC and delivery services, funded by government or donor programs**(4)**. Private facilities, in contrast, require out-of-pocket payment for each visit and for delivery, which can deter poor families. In our data, many women who did not attend ANC cited financial constraints, which underscores how cost is a barrier (**table 2)**. It stands to reason that those who depend on private clinics might cut back on care if they cannot afford it – for example, some might skip ANC or opt to deliver at home to avoid hospital bills. Additionally, public facilities often have community health workers or networks (e.g., village health committees) actively mobilizing women for ANC and delivery, something less common in private sector. The significant public/private gap we observed echoes national surveys showing far lower service coverage among women in the lowest wealth quintiles (who likely cannot access private care)**(7)**. It also resonates with the outcomes of Nigeria's Free Maternal and Child Health programs – when such programs were implemented in public facilities, they led to increased service utilization and reduced out-of-pocket expenditure **(4)**. Onwujekwe et al. (2019) documented that a national free MCH scheme (2009–2015) significantly improved facility functionality and increased demand for ANC and delivery services, particularly among the poor**(4)**. Our findings reinforce the importance of strengthening public health infrastructure and financing: making ANC and delivery services affordable (or free) and geographically accessible through public facilities is crucial to sustain high uptake. Conversely, the private sector should be engaged through regulation or partnerships – for instance, accreditation and subsidy of private providers could ensure that women who prefer private care are not financially penalized and can still access quality ANC and safe delivery.

Perhaps the most actionable finding is the *powerful role of antenatal care attendance* in predicting facility delivery. Women who attended ANC had dramatically higher odds of delivering in a hospital or clinic. This is consistent with ample evidence from Nigeria and other countries that ANC is an entry point to the health system that encourages skilled birth attendance (**table 3)**. During ANC visits, women receive health education on birth preparedness, the benefits of delivering with a skilled attendant, and information about where to go in case of complications **(4)**. ANC also familiarizes women with the healthcare facility and staff, potentially reducing fear or uncertainty around seeking care for delivery. Our data suggest that in Kaduna, those who never attended ANC often ended up giving birth at home (perhaps relying on traditional birth attendants or family), whereas those who had at least one ANC were much more likely to give birth under skilled care (5). The adjusted analysis shows this is not merely a correlation due to other factors: even controlling for education (proxied by ethnicity or zone) and facility access, ANC attendance itself independently boosts facility delivery likelihood (6). This aligns with a study by Oyedele et al. (2023) who found that women with "optimal ANC" were far more likely to avoid home delivery than those with suboptimal or no ANC – indeed, they reported only 5.8% of women with inadequate ANC delivered in facilities vs 48% of those with adequate ANC (**table 3)** ANC thus acts as a gateway. The policy implication is clear: improving ANC coverage (especially early initiation and completion of recommended visits) can directly translate into higher rates of safe deliveries and potentially better maternal-newborn outcomes**(6)**. However, our findings also hint at a gap in the Central zone where ANC attendance is high but facility delivery is low – suggesting that simply attending ANC is not enough if certain barriers (like transport or emergency obstetric readiness) prevent conversion of ANC clients into facility deliveries. Hence, quality ANC programs must also address the continuum of care, ensuring women can reach a facility when labor starts (e.g., through birth plans, emergency transport schemes, male partner engagement, etc.).

The lack of significant effect of "facility class" in adjusted models is somewhat surprising, but it may be due to data limitations. Intuitively, one might expect that being in an area served only by a primary health clinic (which may lack surgical obstetric capacity) could lower the chance of facility delivery, versus having access to a secondary or tertiary hospital. Our unadjusted results did show a strong association ($\chi^2 = 59.4$, $p < 0.001$) – presumably many home births were among those who only had a primary center nearby that might not conduct deliveries beyond basic care. However, in the logistic regression, once we accounted for whether the facility was public and for other factors, "class" lost significance. This could be because most primary facilities in Kaduna do conduct normal deliveries and refer complications, so as long as a woman is motivated (and perhaps if the primary center is free), she will use it. Additionally, facility class correlates with location (rural areas have only primary centers) and with whether it's public (all tertiary are public), so the model might have collinearity. Therefore, we shouldn't conclude that facility level doesn't matter at all – higher-level facilities offer more comprehensive emergency care which is vital. But our data suggest the *availability* of any functional facility (even a primary health center) combined with the willingness to use it (often driven by ANC engagement and affordability) is the key. Many primary health centers in Nigeria are now being upgraded to provide basic emergency obstetric care; this is a positive step to ensure that even women in rural communities can deliver safely without traveling far.

Comparison with Other Studies and Guidelines

Our findings corroborate and add local detail to the broader literature on maternal health service utilization. Nationally and regionally, studies have consistently found that factors such as education, wealth, urban residence, and media exposure are strong predictors of using ANC and skilled delivery services**(1)**. Although our dataset did not include direct measures of education or wealth, some proxies can be inferred: the high public facility usage suggests many women were lower-income, yet their ANC and delivery rates were reasonably high, indicating perhaps the success of public health initiatives in Kaduna. It's known that Nigeria's urban-rural gap is large – only 23% of rural women deliver with a skilled attendant compared to 67% in urban areas**(7)**. Kaduna's overall facility delivery rate of 76% in our sample is higher than expected for a largely rural state, implying our sample might have been skewed towards facility users. Even so, the internal patterns (Fulani vs others, Central vs Southern zone) mirror those observed in national DHS data which show Northern rural, poorer women (many of whom are Fulani or Hausa) lagging behind**(5)**.

Our results underscore key barriers identified in the Three Delays model commonly referenced in maternal health: Delay 1 (decision to seek care) is influenced by socio-cultural factors (e.g., whether a woman or her family values facility delivery) and cost, and Delay 2 (reaching care) is influenced by distance and transport. The prominence of financial constraints and socio-cultural barriers among non-ANC users in our study directly speaks to Delay 1 issues – if a family cannot afford care or does not approve of it, the woman will not even start ANC**(5)**. The Central zone's lower facility delivery despite high ANC could point to a Delay 2 problem – women intend to deliver in facility (since they attended ANC) but perhaps cannot overcome the transportation or distance issues when labor starts. Delay 3 (receiving adequate care at facility) was not measured here, but the lack of staff mentioned by a few women suggests quality of care concerns exist, albeit to a smaller extent. These insights align with qualitative studies in northwest Nigeria that have reported high costs (for delivery kits, drugs, unofficial

fees), long distance to hospitals, and traditional norms (like delivering at mother's home) as persistent barriers to maternal service utilization**(6)**.

From a policy perspective, our findings support ongoing efforts by Nigerian authorities and international agencies. The WHO's recommendation of at least eight ANC contacts is ambitious, given that even attaining four ANC visits remains a challenge for many Nigerian women (only ~50% achieve four visits nationally**(4)**). Kaduna State will need to build on the progress indicated by our data (79% had at least one ANC) to ensure not just one, but adequate and early ANC visits. Similarly, the push for universal skilled birth attendance (WHO's Every Birth with a Skilled Attendant initiative)**(1)**requires addressing exactly the barriers we identified. Interventions that have shown success elsewhere, such as conditional cash transfers or voucher schemes to offset costs, community education campaigns to shift cultural norms, and male partner involvement in maternity care, could be adapted to Kaduna's context. For instance, involving husbands in ANC counseling sessions can help secure familial support for facility delivery – culturally appropriate male engagement has improved maternal service uptake in parts of northern Nigeria according to some pilot projects (reference to Nigerian health policy or program reports can be inserted).

Moreover, our data highlight the critical role of the public health sector. Strengthening primary health centers (PHCs) to provide quality ANC and safe delivery (including managing common complications or stabilizing and referring) will directly benefit communities. Kaduna State has been part of Nigeria's PHC revitalization initiative, and our findings encourage continuing investment in PHCs, especially in rural Central zone. We also saw that when public services are accessible, utilization is high, indicating latent demand among women if barriers are removed. This resonates with the experience of the Free Maternal Health Program, which when active, significantly increased utilization**(4)**. Although that specific program ended in 2015, the new **Basic Health Care Provision Fund (BHCPF)** in Nigeria is intended to reinvigorate such efforts**(4)**. Ensuring Kaduna effectively implements BHCPF (which provides funding to PHCs per capita for free maternal/newborn services) could tackle the financial barrier noted by 49% of our non-ANC attendees. Additionally, improving the quality and friendliness of services can address some socio-cultural hesitancy – if women feel respected and satisfied during ANC, they are more likely to come back for delivery**(5)**. Culturally sensitive training for health workers (e.g., female providers, privacy measures, and language concordance for different ethnic groups) may help in this regard.

Limitations and Strengths

It is important to acknowledge the limitations of this study. First, the cross-sectional design precludes causal conclusions – while we speak of predictors, we cannot definitively prove causation. For example, ANC attendance is associated with facility delivery, but there may be unmeasured factors (like women's health consciousness or autonomy) that influence both. Second, the data were collected via health facilities, which may over-represent women who are already inclined to use services; women who delivered at home and never came to a facility (even postnatally) might be under-represented. This could lead us to overestimate coverage levels (79% ANC, 76% facility delivery) relative to the true population values. However, since we did capture 141 home deliveries, the sample does include non-users to some extent. Third, some potentially important variables were not available in the dataset: maternal education, age, parity, and income level, among others. These could confound or explain some of the observed associations. For instance, the Central zone's low facility delivery might be partly due to higher average parity or more grandmultiparas who traditionally deliver at home – but we could not assess that. The logistic models attempted to adjust for what was available, but residual confounding is possible. Fourth, certain subgroups were very small (e.g., tertiary facility users n=6, Igbo n=5), which makes those specific estimates unreliable. We exercised caution in interpreting those and focused on broader patterns. Despite these limitations, a strength of the study is that it provides region-specific insight within northern Nigeria, using primary data from nearly 600 women. The combination of service statistics and self-reported reasons for non-use enriches our understanding of not just "how many" but "why" some women are left behind. The use of both bivariate and multivariate analysis helps distinguish spurious associations from more robust predictors.

V. Conclusion

In this cross-sectional study of maternal health service utilization in Kaduna State, Nigeria, we found that while a majority of women are accessing antenatal care and giving birth in health facilities, a significant minority still do not benefit from these life-saving interventions. ANC attendance was 79%, and facility delivery 76%, in our sample – higher than national averages but leaving room for improvement. The key determinants of service use include geographic zone, ethnicity, and health facility factors. Women in the Central zone and those of Fulani ethnicity were less likely to fully utilize services, pointing to geographic and cultural pockets of low coverage. By contrast, women served by public facilities and those who attended ANC were much more likely to have a safe, facility-based childbirth. Not attending ANC was associated with dramatically lower odds of delivering in a health facility, underscoring the critical importance of ANC as a gateway to skilled delivery.

The implications for public health policy and practice in Kaduna State (and similar settings) are clear: targeted efforts are needed to **close the gaps in ANC and skilled delivery coverage**, especially for socio-culturally marginalized groups and in under-served regions. We offer the following recommendations:

- **Strengthen Community ANC Outreach:** Health authorities should expand outreach programs to identify pregnant women early and encourage ANC attendance, particularly in communities with low uptake. Strategies may include deploying community health extension workers to conduct home visits, mobile ANC clinics in remote settlements (e.g., for nomadic Fulani communities), and collaborating with traditional and religious leaders to promote the importance of ANC. Early and regular ANC not only improves pregnancy monitoring but also builds a connection to the healthcare system, making subsequent facility delivery more likely**(5)**.
- **Enhance Access to Affordable Maternal Services:** Financial barriers remain a major deterrent to care**(table 1)**. The state should implement or reinforce policies that make maternal health services free or highly subsidized for all women, especially at primary care level. This could involve fully funding the antenatal profile (lab tests) and delivery costs through the Basic Health Care Provision Fund or state budget. Experience from Nigeria's prior free maternal health schemes shows that removing user fees increases service utilization and reduces out-of-pocket spending**(4)**. In tandem, transportation support is crucial – establishing emergency transport systems or providing ambulance services/vouchers in rural areas (for example, a dedicated toll-free number and community drivers network) can help women reach facilities during labor, mitigating the distance barrier.
- **Invest in Public Primary Health Facilities:** Our findings highlight that public-sector facilities are central to delivering ANC and obstetric care in this population. Government should continue to improve the capacity of primary health centers to deliver quality antenatal and delivery care. This includes ensuring consistent staffing (midwives, nurses, community health officers) at PHCs, adequate medical supplies and essential drugs (e.g., oxytocin, magnesium sulfate), and functional referral links to higher centers for complications. Upgrading select PHCs to provide basic emergency obstetric and newborn care (BEmONC) can enable more women to deliver safely near their homes. Such investments will particularly benefit zones like the Central senatorial district, which may currently lack easy access to comprehensive obstetric care.
- **Address Socio-Cultural Barriers through Community Engagement:** Nearly half of the women who skipped ANC cited socio-cultural reasons **(Table 1)**, reflecting issues like spousal disapproval, traditional beliefs, or low perceived need for formal care. Culturally sensitive health education campaigns are needed to change norms around maternity care. Engaging husbands, mothers-in-law, and community influencers in dialogues about the benefits of skilled care can reshape attitudes. For example, male advocacy groups or "community champions" could be empowered to support women's health. Additionally, integrating aspects of respectful maternity care – such as allowing birth companions, ensuring privacy, and communicating in local languages – can make health facilities more acceptable to women who currently fear or distrust them **(5)**. Leveraging existing community structures (women's groups, religious institutions) to disseminate messages and even provide group ANC sessions could improve acceptance of ANC and facility delivery as the norm.
- **Targeted Interventions for Vulnerable Groups:** Special initiatives should target the Fulani and other underserved minorities. This might involve training and deploying "nomadic healthcare workers" or liaising with veterinary/outreach services that already work with pastoralist communities to also convey maternal health services and education. Tailoring service delivery modalities – for instance, scheduling ANC on market days or near grazing routes – could improve uptake in these communities. Ensuring that healthcare providers respect cultural practices (within safe limits) can also build trust; for example, accommodating traditional birth positions or post-partum rituals in facility where possible.

By implementing these strategies, Kaduna State can move closer to the national and global targets for maternal health. Increasing ANC attendance and facility-based deliveries will likely translate into reductions in maternal and newborn mortality, given the known link between skilled care and improved outcomes**(1)(5)**. Our study's findings serve as evidence to guide policymakers: investments in public health infrastructure, financial risk protection, and community engagement are all complementary pieces needed to solve the maternal health puzzle. In conclusion, while progress has been made in Kaduna as indicated by relatively high service utilization rates, concerted efforts focusing on equity – ensuring *all* women, regardless of location, ethnicity, or economic status, can access quality ANC and safe delivery – are essential. Such efforts will not only save lives but also advance Nigeria's commitment to the Sustainable Development Goals and the global goal of ending preventable maternal and child deaths.

Declarations

Ethics Approval and Consent to Participate: The study was done according to Helsinki's declaration and National Code of Health Research Ethics (2006) [22], [21] Federal Ministry of Health, Nigeria, with approval given by Kaduna state ministry of Health ethical committee with approval number NHREC/17/03/2018/ MOH/ADM/744/VOL1/111021 dated December 12, 2023.

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