Inequities and Disparities: An Investigation of Antenatal Visits in Mozambique

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Abstract:

Background: Mozambique is a southeastern sub-Saharan African country with the highest maternal, infant, and neonatal mortality rates. Low antenatal visits were often associated with high levels of these indicators. This study examined the changes in antenatal care and the factors affecting antenatal visits for policy making.

Methods: Data from the Mozambique DHS (2022-23) were used for the analyses. The variables were selected from the individual-interpersonal-community framework, and zero-inflated Poisson regression was used to test the factors associated with antenatal visits.

Results: Higher education among women (IRR:1.057; OR: 0.34) and partner's education (IRR:1.155), having a job [either agriculture (OR:0.341) or non-agriculture (IRR: 1.077; OR: 0.341)], higher wealth (IRR>1; OR<1), and use of the Internet (IRR:1.046) were positively associated with antenatal visits. Problems in obtaining permission (OR:2.35), not wanting to go alone (OR: 1.97), longer distances (IRR: 0.966), and being in a rural area (OR:2.38) were negatively associated with antenatal visits.

Conclusion: Antenatal visits to Mozambique were severely limited by individual, interpersonal, and community inequities. These can be overcome by tailored policymaking addressing these barriers instead of a single and uniform maternal care policy.

Keywords: Antenatal care, Socio-ecological, Zero-inflated poisson regression, Inequities, Disparity, Mozambique.

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1. INTRODUCTION

Antenatal visits are defined as the care provided by health professionals to pregnant women to ensure the safety of both mothers and infants at birth [1]. Reducing neonatal mortality, especially in the middle and low-income countries, as the number of antenatal visits is considered a prerequisite [2, 3]. Mozambique, a sub-Saharan country located in southeastern Africa, had one of the highest neonatal mortality [4, 5]. Frelimo (the ruling

party of Mozambique) envisioned a primary care approach focused on preventive care to elevate Mozambique from health crises, but the civil war of 1977 derailed their plans, as the civil war from 1977 to 1992 destroyed the country's infrastructure [6, 7]. Postwar Mozambique started off in the worst manner, as the country had one of the highest maternal infant and neonatal mortality rates worldwide [8, 9]. With their consistent efforts, Mozambique has been able to reduce its mortality rates since the

2000s, and is currently four times less than that from the start of the millennium, but it still remains in the picture [8].

While mortality rates have decreased, fertility rates have increased, as the country has one of the highest rates of fertility, with 1/10th of teenage girls having at least one baby 5. Despite improvements, the country's health infrastructure is not capable of addressing rising fertility needs [10, 11]. Apart from supply side deficiencies, several personal, social, and cultural barriers affect a woman's decision to use a health facility for antenatal care [10, 12]. Thus, to reduce the mortality rates of the country, one should understand the individual, interpersonal, and community barriers associated with antenatal visits to design policies appropriately. Therefore, we adapted the individual-interpersonal-community framework of the socio-ecological theory for this study and used a zero-inflated Poisson (ZIP) regression model to analyze the factors associated with antenatal care visits.

This study attempted to understand the changes in antenatal visits over the years and the factors associated with antenatal visits using the Mozambique 'Inquérito Demográfico e de Saúde 2022-23' (IDS) conducted by the Demographic and Health Surveys (DHS), Instituto Nacional de Estatística (INE), and Ministério da Saúde (MISAU) [13]. Mozambique has been able to reduce maternal mortality and neonatal mortality, but the country still faces challenges in ensuring adequate antenatal care utilization. Previous studies conducted in the country and the sub-Saharan African region focused more on the odds of making at least one visit and did not explore the factors affecting further visits. Our study used the ZIP, which provides insights into the factors that affect at least one visit and further visits, enabling nuanced policy suggestions. The use of the latest IDS data would help provide nuanced insights into policymaking in sub-Saharan African countries. Our study incorporates the I-I-C model as the theoretical rationale for variable selection. The I-I-C model is a relatively new model that emerged from socio-ecological theory, thus providing a novel theoretical basis for this study. The objective of this study was to identify the individual, interpersonal, and community-level variables associated with antenatal visits of Mozambican women and their changes over the years. Our study provides a comprehensive set of implications and policy suggestions that would be beneficial in improving antenatal visits in Mozambique and neighboring sub-Saharan African countries.

2. METHODS AND MATERIALS

2.1. Source of Data and Sampling Design

This cross-sectional analytical study used secondary data from the Mozambique National Demography and Health Survey (2022-23). The survey was conducted as part of the eighth round of demographic and health statistics (DHS). For the survey, 6168 women were interviewed about their socio-demographic background, marriage and sexual life, family planning, and so on. The DHS employs two-stage cluster sampling: the first stage at the enumeration areas and the second stage at the households within the selected enumeration areas. The samples were representative of national, regional, and resident levels [14].

2.1.1. Sample Inclusion Criteria

Of the 6168 participants, we included women who had already had children or were pregnant at the time of data collection. After removing the missing data, 4040 samples were selected for this study.

2.2. Variables Selected for the Model

The dependent variable was the number of antenatal visits by women. The independent variables were selected using the individual-interpersonal-community framework of the socio-ecological model. Sun *et al*. and Jalu *et al*. suggested that age, education, income, ethnicity, and women's ability to make decisions are individual factors. They recommended social support, husband's education, marital status, and religion as variables at the interpersonal level, whereas the community level comprised access to information, location of the household, and perceived barriers to care [15, 16].

Based on the adapted theoretical framework, the variable inclusion criteria were as follows:

2.2.1. Individual Factors

The variables selected for this study under individual factors were age, education, wealth quintile, and occupation.

2.2.2. Interpersonal Factors

In the interpersonal category, marital status, partner's education, Getting Permission, not wanting to go alone, and religion were considered.

2.2.3. Community Factors

Variables such as location of the house, distance of facility, frequency of using newspapers, TV, radio, and the internet were considered as community factors.

2.3. Tools used for the Study

RStudio (Version: 2024.04.01) and Microsoft Excel (2019) were used for the analysis. The zero-inflated Poisson regression (ZIP) was used to examine the factors associated with the number of antenatal visits in Mozambique. Zero-inflated and negative binomial models were used when there was overdispersion (mean< variance) in the dependent variable caused by excess zeroes and non-zeroes [17]. Table **1** provides the descriptive statistics of the variable 'number of visits to antenatal care,' where the overdispersion ratio (variance/mean) is greater than 1 (1.05), indicating overdispersion in the presence of zeroes, and it resolves when zeroes are removed (overdispersion ratio = 0.67 <). Thus, zero-inflated or negative binomial models provide a better fit than regular Poisson regressions [18, 19].

Table 1. The descriptive statistics of the dependent variable.

Model	Median	Mean	Variance	Overdispersion ratio
With Zeroes	4	3.814	4.008608	1.051025
Without Zeroes	4	4.22	2.835856	0.672004

Table 2. Model fit of various count regression models.

Models	AIC	BIC	Log
Poisson Regression	16540.37	16767.32	-8234.186 on 36 Df
Negative Binomial	16542.42	16775.67	-8234.21 on 37 Df
ZINB	15931.9	16392.09	-7893 on 73 Df
ZIP	15929.9	16383.79	-7893 on 72 Df

Notes: *Source: Author's calculation from Mozambique DHS-8*
*Df= degrees of freedom*
ZIP=Zero inflated Poisson Regression
ZINB=Zero inflated Negative Binomial Regression

The Zero-inflated Poisson Regression (ZIP) was selected after considering Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and theoretical considerations. Four-count regression models were considered in the study, and hurdle models were not used for the analysis. The zero-inflated model accommodates and distinguishes both sampling and structural zeroes, as some women would not visit antenatal care in any circumstance (structural zeroes) and some women did not visit antenatal care by chance during the study period, even though they might visit them in the future (sampling zeroes). The Hurdle model considers zeroes to be sampling zeroes, which may not fit the theoretical framework [17].

Table **2** shows the model fit of various count regression model statistics. Poisson and negative binomial regressions have significantly higher AIC and BIC values, along with a lower log likelihood with fewer degrees of freedom, indicating a poorer fit. ZIP provided a better fit to the model, with the lowest AIC and BIC values and a relatively higher log likelihood.
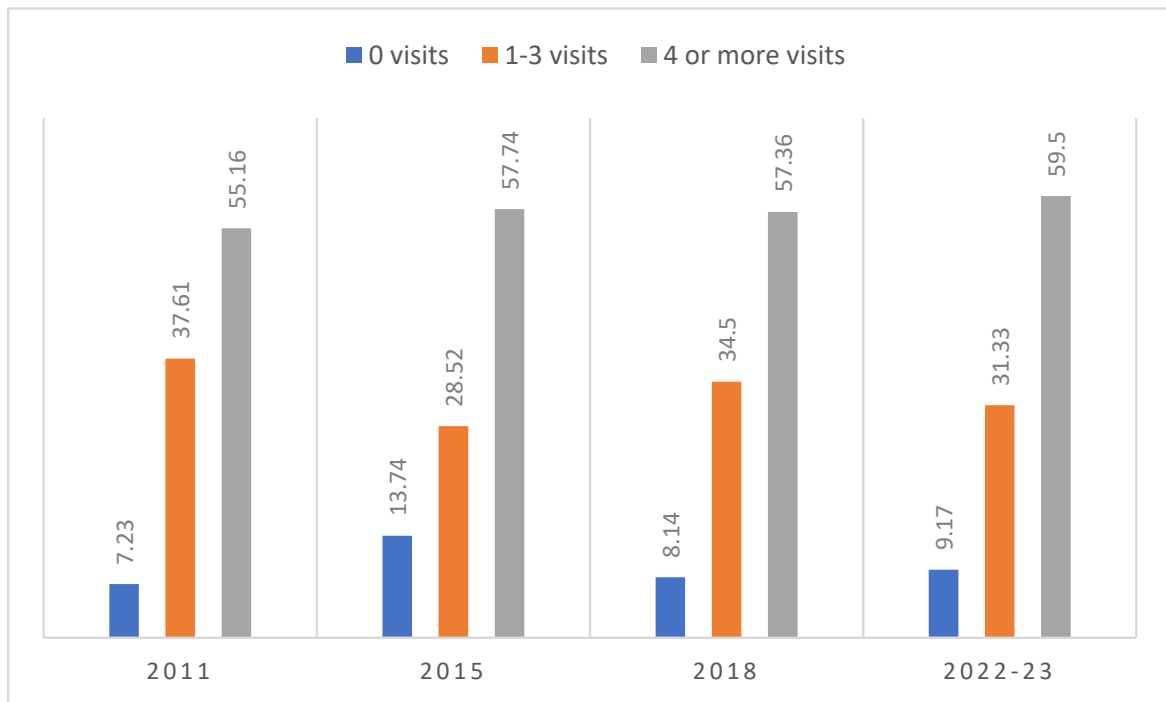
Fig. (1). Number of Antenatal visits over the years (in%).

3. RESULTS

3.1. Changes in Antenatal Visits Over the Years

The multiple bar diagram in Fig. (**1**) presents the relative change in the number of antenatal visits over time. The number of zero visits increased from 7.23% in 2015 to 13.75%; however, the percentage of 1-3 visits fell by 10% at the same time, and the percentage of four or more visits increased by 1.6%. The number of zero visits decreased to 8.14% in 2018 and increased marginally to 9.17% in 2022, whereas the percentage of four or more visits increased to 59.5%, indicating effective health management.

3.2. The Respondent Profile

The respondent profile is shown in Table **3**, and 4040 samples were selected for the study after eliminating missing values from the datasheet. In the age category, most respondents belonged to the 20-24 (29.8%) and 25-29 (22.37%) categories, with more than 50% of the respondents. Approximately 76% of the respondents had education at the primary level (47.6%), or no education at all (28%), and most of them lived in rural areas (70%). The wealth quintile was almost equally distributed, except for the richest category (16%), with approximately 20% of the respondents. Religion-wise distributions were evangelical (28.36%), Catholic (23.54%), and Islamic (22%). The respondents mostly had partners with an education of either primary (38%) or secondary (28%) level, and 20% had partners with no education. Most respondents lived with their partners (63%) instead of a formal marriage (37%). When it comes to reading newspapers, most of the respondents revealed (92%) that they had never read it; similarly, the majority did not listen to the radio (64%), watch TV (69%), or use the Internet (83%). However, when it came to using them regularly, TV had the highest number of users (23%). Most of the respondents had no problem getting permission (94%), nor did they need a company to visit a hospital (90%). Distance to the facility was a problem for 45% of respondents.

Table 3. General information of respondents.

Variable	Category	Frequency	Percentage
Age	15-19	554	13.71
	20-24	1204	29.8
	25-29	904	22.38
	30-34	645	15.97
	35-39	472	11.68
	40-44	180	4.46
	45-49	81	2
Location	Urban	1212	30
	Rural	2828	70
Education	No education	1130	27.97
	Primary	1924	47.62
	Secondary or above	986	24.41
Religion (Catholic)	Catholic	951	23.54
	Islamic	892	22.08
	Zion	621	15.37
	Evangelical	1146	28.37
	Others	430	10.64
Frequency of reading newspaper	Never	3727	92.25
	Less than a week	208	5.15
	Regularly	105	2.6
Frequency of listening to radio	Never	2621	64.88
	Less than a week	656	16.24
	Regularly	763	18.89
Frequency of watching TV	Never	2791	69.08
	Less than a week	306	7.57
	Regularly	943	23.34
Use of Internet	Never	3338	82.62
	Yes, within last 12 months	633	15.67
	Yes, before last 12 months	69	1.71
Wealth Quintiles	Poorest	815	20.17
	Poorer	840	20.79
	Middle	851	21.06
	Richer	860	21.29
	Richest	674	16.68

(Table 3) contd.....

Variable	Category	Frequency	Percentage
Marital Status	Married	1501	37.15
	Living together	2539	62.85
Education of the partner	No education	831	20.57
	Primary	1532	37.92
	Secondary	1135	28.09
	Higher	100	2.48
	Do not know	442	10.94
Occupation of the respondent	Not Working	2597	64.28
	Other than agriculture	639	15.82
	Agriculture	804	19.9
Getting Permission	No Problem	3796	93.96
	Big Problem	244	6.04
Distance to the facility	No Problem	2226	55.1
	Big Problem	1814	44.9
Not wanting to go alone	No Problem	3635	89.98
	Big Problem	405	10.02

Note: Source: Mozambique DHS-8.

3.3. The Zero-inflated Poisson Regression Model

Table **4** presents the results of the zero-inflated Poisson regression model. The column count model shows the incidence rate ratio (IRR) of the frequency of visits, and the zero-inflated column shows the odds of zero visits at antenatal care. Among the individual factors, wealth, education, and occupation were significant factors in both the incidence of visits and the odds of zero visits. The poorer (IRR: 1.061 and OR: 0.6937), middle (IRR: 1.143 and OR: 0.6063), and richer (IRR: 1.239 and OR: 0.1314) classes had a higher incidence of visits and lower odds of non-visits than the poorest. The richest group had a significantly higher incidence of visits (IRR: 1.279), but despite having lower odds of non-visits (OR: 0.59), it was not statistically significant, possibly due to the small sample size. Education is another variable that influences both the incidence of visits and the odds of zero visits; primary education (IRR: 1.042 and OR: 0.5623) and secondary education (IRR: 1.057 and OR: 0.3436) had both lower odds of zero visits and marginal yet significantly higher incidence of continued visits (significant at 10%), compared to women with no education. Women who had jobs either in agriculture (OR: 0.341) or other sectors (OR: 0.3436) had lower odds of zero visits than women with no job, and the latter also had a higher incidence of antenatal visits (IRR: 1.077). However, those who work in agriculture would have the same incidence of visiting antenatal care as women with no job. Age was an insignificant parameter in both models.

Table 4. The factors associated with the antenatal visits of women in mozambique.

Factors	Variables (Reference)	Categories	Count Model	Zero-inflated model
			IRR	OR
Intercept			3.235****	0.3021**
Individual	**Age (15-19)**	20-24	0.984	0.9033
		25-29	0.979	1.2042
		30-34	0.983	1.1437
		35-39	0.996	1.1012
		40-44	1.013	0.9717
		45-49	1.02	1.8944
	Education (No education)	Primary	1.042*	0.5623****
		Secondary or above	1.057*	0.3436**
	Occupation of the respondent (Not working)	Other than agriculture	1.077***	0.1611***
		Agriculture	1.013	0.341****
	Wealth Quintiles (Poorest)	Poorer	1.061*	0.6937**
		Middle	1.143****	0.6063**
		Richer	1.239****	0.1314****
		Richest	1.279****	0.5978

(Table 4) contd.....

Factors	Variables (Reference)	Categories	Count Model	Zero-inflated model
			IRR	OR
Interpersonal	Religion (Catholic)	Islamic	0.972	0.2362****
		Zion	1.092***	0.98
		Evangelical	1.112****	0.8701
		Others	1.095***	0.8018
	Marital Status (Married)	Living together	0.983	0.9001
	Education of the partner (No education)	Primary	1.037	0.5463****
		Secondary	1.052*	0.2641****
		Higher	1.155***	6.89527E-07
		Do not know	0.996	0.6213**
	Getting Permission (No Problem)	Big Problem	0.948	2.3583****
	Not wanting to go alone (No Problem)	Big Problem	1.033	1.9776****
Community	Location (Urban)	Rural	1.006	2.3861**
	Frequency of reading newspaper (Never)	Less than a week	1.028	5.18482E-07
		Regularly	0.993	1.45098E-06
	Frequency of listening to radio (Never)	Less than a week	0.986	0.5049**
		Regularly	0.994	0.8635
	frequency of watching TV (Never)	Less than a week	0.96	0.2339*
		Regularly	1.004	0.6297
	Use of Internet (Never)	Yes, within last 12 months	1.046*	7.87E-08
		Yes, before last 12 months	0.952	3.02196E-07
	Distance to health facility (No Problem)	Big Problem	0.966*	0.9677

Notes:
Source: Author's calculation from Mozambique DHS-8
Asterisks (*) indicate significant parameter: '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1,
Number of iterations in BFGS optimization: 86,
Log-likelihood: -7893 on 72 Degrees of freedom,
AIC: 15929.9, BIC: 16383.79

Among interpersonal factors, religion and the education of partners were significant predictors of both the incidence and frequency of visits. The variables 'getting permission' and 'not wanting to go alone' were significant predictors of non-visits among Mozambican women. Catholic women had a similar incidence of visiting antenatal care as Muslim women, but women who believed in African Zionism (IRR: 1.092), Pentecost (IRR: 1.112), and other religions (IRR: 1.095) had a higher incidence of antenatal visits than Catholic women. However, apart from Islam (OR: 0.2362), all other religions had insignificantly lower odds of visiting antenatal care compared to Catholic women. Women with partners with higher than secondary levels of education had a higher incidence of visits (IRR: 1.052), and those with primary (OR: 0.546) and secondary (OR: 0.264) levels of education had significantly lower odds of not visiting antenatal care at least once. Women who faced significant problems in getting permission (OR: 2.358) and not wanting to go alone (OR: 1.977) had significantly higher odds of non-visits than those with no problems. Marital Status was statistically insignificant.

Community factors, such as Internet use and distance to health facilities, were marginally significant parameters in determining the incidence of visits (significant at 10%). The location, frequency of listening to the radio, and watching TV were significant predictors in determining whether they visited antenatal care at least once. People who used the Internet within the last 12 months of the survey had a higher incidence of antenatal care visits (IRR: 1.046) than those who never used it. People who faced difficulties in visiting antenatal care due to their distance had a lower incidence of visiting them (IRR: 0.966) than those who did not face any problems. Women living in rural areas had higher odds of not visiting antenatal care at least once than urban women (OR: 2.38), and women who listened to radio (OR: 0.5) and those who watched TV (OR: 0.234) had lower odds of non-visits than women who never used it. Regular users of either gadget had lower odds, but they were insignificant, likely because of the low sample distribution. The frequency of reading newspapers was neither a significant predictor of incidence nor visits to zero.

4. DISCUSSION

Mozambique has elevated its status from a war-trodden country at the start of the century to one of the few countries in sub-Saharan Africa to reduce maternal mortality fourfold [8]. Although the country has improved in terms of maternal healthcare, infant and neonatal mortality rates are comparable to those of other countries

in the region. Macicame *et al*. attributed this to the poor quality of antenatal, pregnancy, and postnatal care in the country [20]. A meta-analysis by Wondemagegn *et al*. suggested that fewer antenatal visits were often associated with a higher risk of neonatal mortality [2]. The number of zero antenatal visits in the country has been stable at around 7%-13% over the years, which is largely attributed to supply chain deficiencies and the inaccessibility of health services [10]. Zero-inflated Poisson regression was used to analyze the association of individual, interpersonal, and community variables with the number of antenatal visits.

4.1. Individual Factors

The wealth quintiles were significant in both whether they visited the antenatal care unit and the incidence of visits, as women belonging to higher wealth quintiles had a higher chance of visiting them frequently than the poorest of the population. Over 70 percent of the population in Mozambique is currently living in poverty, and with the evidence from this study, it can be inferred that antenatal visits are more of a luxury than a necessity for an average Mozambican woman [11]. Education is another significant predictor of antenatal visits; women with higher levels of education have lower odds of non-visits, and a higher incidence of antenatal visits is observed slightly more in women with secondary and higher levels of education. Similar findings were reported by Biza *et al*. in their qualitative study on antenatal visits in southern Mozambique, as the less educated are less aware of the importance of antenatal care and may have cultural beliefs that interfere with their judgement [10]. The results of this study align with those of Tesfay *et al*.'s study in Ethiopia; however, the nature of this relationship differs. They found that primary education had a higher incidence of antenatal visits, but the odds of visiting antenatal care were similar to those of women with no education. However, this study found that the odds and incidence rates in women with primary education were higher than in women without education [21]. Sun *et al*., in their review of the application of the socio-ecological model to pregnant women's health, discussed low wealth and education as major barriers to physical activity due to its influence on accessibility and awareness, and similar studies conducted on antenatal visits in sub-Saharan Africa validated these findings [12, 15, 16].

Women working in sectors other than agriculture had a higher incidence of visits and lower odds of non-visits compared to women with no job, and women working in the agriculture sector had lower odds of non-visits but a similar incidence of higher visits. In their review of antenatal visits in sub-Saharan Africa, Okedo-Alex *et al*. noted that the low incidence of visits by women working in agriculture may be due to their lack of or delayed initiation [22]. The reason for delayed initiation could be wealth constraints and a lack of accessibility to healthcare, as agriculture is predominantly a rural activity [22, 23]. Age was an insignificant parameter in both models, indicating that women of all ages had a similar

incidence of use and odds of non-use, which was also observed in Guinea and Mali [12]. This finding contradicts that of similar studies conducted in this region [16, 21-23].

4.2. Interpersonal Factors

Catholics in the country have a significantly lower incidence of visits to religions other than Muslim women; however, the latter is more likely to visit antenatal care once than the former, indicating that Catholic women are least likely to visit the facilities at least once or use them frequently. This is likely due to the orthodox nature of the Catholic women, which would prevent them from using modern reproductive services, these findings are corroborated by studies conducted in Malawi, Zambia, Mali, and Ethiopia [12, 24, 25]. However, this finding is contradictory in other sub-Saharan African countries, such as Nigeria and Zimbabwe, where Christian women are more likely to use them over Muslims [12, 22, 24]. Women with an educated partner are more likely to have a higher incidence of visits and lower odds of non-visits, indicating that women with highly educated partners will have a better support system at home than women with partners with no education [12, 15, 23]. Similarly, women who face restrictions from their partners/parents in obtaining permission to visit a hospital or have problems going there alone have higher odds of non-visits, indicating a lack of support systems [12, 15].

4.3. Community Factors

Evidence suggests that women living in rural areas are twice as likely as their urban counterparts to not visit antenatal care. The study also found that women who perceived distance to the health facility as a big problem had marginally higher odds of non-visits. This clearly indicates a lack of geographic accessibility for health services in the rural areas of Mozambique owing to a lack of public infrastructure, natural disasters, and healthcare [10, 11]. Geographic inaccessibility is a common theme in sub-Saharan Africa, and studies conducted in Nigeria, Ethiopia, Zambia, Mali, Malawi, and Guinea have reported similar findings [12, 22-24]. Women who used the Internet, radio, or television were more likely to visit antenatal care facilities at least once than women who never used them. Sun *et al*. pointed out that access to electronic media can positively influence behaviors deemed healthy for pregnant women [15], which is supported by several studies conducted in the sub-Saharan region [12, 25]. However, Belay *et al*., in their study in Ethiopia, found that women are more prone to the recommendations and advice of their partners than mass media or health professionals (Supplementary Material) [23].

CONCLUSIONS AND RECOMMENDATIONS

This study examined the changes in antenatal visits in Mozambique and the factors affecting antenatal visits. The Individual-Interpersonal-Community model was used as the theoretical framework, and zero-inflated Poisson regression was used for the analysis. The number of zero visits has been stable for the past 15 years, but the proportion of

women visiting antenatal care four or more times has increased. While analyzing the factors associated with antenatal visits in Mozambican women, it was found that individual, interpersonal, and community factors were significant predictors of both the incidence of visits and the odds of non-visits. There is severe wealth and education inequity in antenatal visits, and women have jobs with both a higher frequency of use and lower odds of non-use. Catholic women found a lower tendency in the incidence of visits, higher odds of non-visits, women who have an educated partner and a very good support system had a higher chance of using antenatal care. Geographic and informational inaccessibility is also a crucial factor, as people living in rural areas have a significantly lower chance of using antenatal care even once, and women who use the Internet, TV, and radio have a higher incidence of antenatal visits. Based on these findings, the following recommendations are made:

- Wealth was found to be a prime barrier in both influencing visits at least once and further visits, with the wealthy having more visits than the poor. The implementation of maternal healthcare policies and financial/insurance schemes that would reduce the financial burden would prompt women to visit antenatal care
- Urban women are far better off than rural women when it comes to antenatal care visits, which is mainly attributed to the lack of proper healthcare in rural areas. Due to financial constraints and a lack of physical infrastructure, women find it difficult to travel to urban areas to receive care. By developing physical infrastructure, such as roads and public transport, and robust primary healthcare in rural areas, Mozambique can overcome rural–urban disparities
- A lack of education for women and their partners, low social support, and strong religious beliefs were identified as barriers to reducing antenatal visits. Thus, maternal policies and awareness classes should be tailored to address their religious sentiments and include their immediate family (partners and other housemates), instead of a uniform national policy
- Employed women were found to have a higher rate of visits to the unemployed, mainly because they had better access to resources and the ability to make their own decisions, as they do not feel permission to visit hospitals, and going alone to the hospitals is a big problem. Thus, creating women-centric employment generation schemes would be beneficial for increasing the number of antenatal care visits and achieving optimal health outcomes for pregnant women
- Information accessibility is also a factor, as women using TV, radio, and the internet are more likely to visit antenatal care. The government can create informational advertisements through these platforms, especially TV and radio, because they are used more by Mozambican women on a weekly/daily basis. They can also increase the accessibility of these gadgets by subsidizing them so that even the poor can afford them. Through information accessibility, the problem of delayed initiation among women can also be resolved

LIMITATIONS OF THE STUDY

The study area was limited to Mozambique; hence, the findings cannot be generalized to other countries. This study used secondary data; therefore, its limitations should be acknowledged. The study was cross-sectional; therefore, a causal effect could not be properly assessed. The variables considered for the study were taken from the I-I-C model; thus, there could be other variables that would capture latent effects that were not explained in this study.

SCOPE FOR THE FUTURE STUDIES

This study was cross-sectional in nature, and future studies should use longitudinal data to make causal inferences. The I-I-C model is not exclusive to studying antenatal visits, and the development of a suitable framework for examining antenatal visits in under-developed countries would be beneficial. Regional differences in antenatal visits can be studied by adopting a mixed Poisson regression method, which will be helpful in developing targeted interventions.

AUTHORS' CONTRIBUTION

The authors confirm their contribution to the paper as follows:

Study conception and Design: AG and BBJ.

Data Analysis and Interpretation: AG and NSJ.

Written the manuscript: AG and PS.

Approval of the final draft before submission: BBJ.

All authors reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

ZIP	=	Zero-inflated Poisson
DHS	=	Demographic and Health Surveys
AIC	=	Akaike Information Criteria

ETHICAL STATEMENT

The study was conducted using the eighth round of Demographic and Health Survey (DHS) data.

CONSENT FOR PUBLICATION

All prior consent and approval were obtained from their respective sources.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the Zenodo at https://doi.org/10.5281/zenodo .13904334 reference number md5:1e9d129922580698 3f816560ca0c6c9f.

CONFLICT OF INTEREST

ACKNOWLEDGEMENTS

SUPPLEMENTARY MATERIALS

Supplementary material is available on the Publisher's website.

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