

# Determinants of Use of Antenatal Care Services in Rural Mali

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**Abstract:** The objective of this paper is to identify the factors affecting the use of antenatal care services in rural areas using the Multiple Indicator Cluster Survey (MICS, 2015). In this framework, logistic regression was used to give the binary dependent variable. In addition, the Poisson regression model and negative binomial model were used to analyze the target variable which is a count variable. The regression results indicate that marital status, educational attainment, rural wealth index, contraceptive use, and number of births are significantly associated with the use of antenatal care among women living in rural areas. On the other hand, the determinants of the number of prenatal care visits are the poor rural wealth index, the level of income satisfaction (very satisfied, fairly satisfied), the use of contraceptive methods, the level of higher education as well as the woman age. The results obtained suggest that we propose a policy to create income-generating activities for women in order to promote the accessibility of health care and to sensitize the rural population on the need for girls schooling. In addition, the state must effectively promote the extension of care supply in rural areas.

**Keywords:** Antenatal Care, Health Care Use, Maternal Health, Pregnancy, Rural Mali

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## 1. Introduction

Sustainable development can no longer be restricted only to economic growth; it is also based on social development and takes into account human dimensions, mainly health. It is in this regard that the World Health Organization (WHO) in its 2005 report entitled "Investing in Development" advocates increased investment in health programs, particularly in mothers and children health status, two categories of the target population of the Millennium Development Goals (MDGs). At a time when the world nations are evaluating the progress made in the framework of the MDGs, the development indicators are not globally appreciable; more specifically for Mali and in particular in the area of access to health care (UN 2010). In the empirical literature, the use of antenatal care has been studied in developing countries [2, 20]. Demographic, cultural, structural and behavioral factors increase the likelihood that a person will seek antenatal care services when

pregnant [3].

The analysis of the use of care is based on the relationship between socio-economic factors and the use health care [7, 11]. Indeed, Addai I. [1] shows that the use of maternal and child health services in rural Ghana tends to be dependent mainly on the level of education of services, religious origin and region of residence. And partially ethnicity and occupation. For [16] believe that the number of antenatal care visits is related to wealth status, age, ownership of health insurance (especially for rural women) and the level of education [19] indicate significant differences in maternal health care use in India by level of education, economic status and region of residence [20] finds that mothers living in the Pacific Ocean region as well as young mothers seem less likely to attend the first visit, but these factors are not related to the number of absences from the antenatal consultation after the first visit. With poisson and negative binomial models and quantile regression, [14] find that, in the Democratic Republic of Congo, the factors that influence the demand for antenatal care are

education, religion, disease, abortion past, the permanent reading of the written press and the subscription to a mutual health insurance [4] obtain the results on the determinants of pregnant women choice of treatment in Cameroon from the nested multinomial logit regression. Her estimations show that a woman's level of education has a significant effect on the type of service choice of the relationship between access to paid employment for pregnant women and the use of modern health services is positive.

The health situation in Mali is very worrying. Globally, one on three women (33%) gave birth at home in the past 5 years preceding the survey [9]. In contrast, two-thirds (77%) of births took place in a health facility, the majority in public sector facilities (63% versus 4% in the private sector). The pregnancy-related mortality rate is 373 per 100,000 live births [9]. In addition, the use of health services is very low. For example, 15% of children under 5 with diarrhea receive oral rehydration solutions (ORS), while these are available in 91.8% of Basic Health Centers. In Mali, the underutilization of health services despite the initiative of Bamako in addition to a degrading level of health of the populations was palpable proof of the failure of health policies [5]. In Mali, the low use of reproductive health services in general, and of Family Planning (FP) in particular, contributes significantly to the diseases and deaths of women during and / or after childbirth and as well as to children under one year of age. This situation is, among other things, the logical consequence of harmful practices, including unwanted, early, close and late pregnancies, clandestine abortions, late seeking of care, difficulties of access and insufficient adequate obstetric and neonatal care.

Nowadays, despite this essential role of women in society, political decision-makers hardly contribute to the specific needs of women. The particular concern of maternity fully justifies this context. According to the estimations made in 2005 by the WHO, a woman dies every sixty seconds from complications related to pregnancy or childbirth; that makes more than 500,000 women each year and ten million to a generation. It is in Africa, in a large scale and especially in sub-Saharan Africa, that the problem of maternal health is more acute. In this region, woman's risk of dying from pregnancy complications is 1 to 2, while it is 1 to 7,300 in developed countries. For instance, the risk for a woman to die from pregnancy-related causes is approximately 1 to 7 in Niger compared to 1 to 17,400 in Sweden. Each year, more than one million children are orphaned and therefore more vulnerable due to maternal death. Around the world, children who have lost their mothers are ten times more likely to die prematurely than their counterparts. Mali is not isolated from this phenomenon; according to the Demographic and Health Survey of Mali (2018) statistics, the proportion of women who have carried out at least one antenatal visit with qualified personnel is high in urban areas than in rural areas (93% compared to 69%). Despite improvements in antenatal care over the past five (5) years, maternal mortality remains high in Mali [9]. Indeed, among the 70% of women who attend at least one antenatal visit, many of them no longer return to ensure continuity of antenatal care. The overall risk of death

among children under the age of 5 is estimated to be 191 per 1,000 live births, or nearly one on five.

Using an econometric analysis of MICS data (2015), this study makes an empirical contribution on the determinants of prenatal health care utilization. To our knowledge, no study in Mali has assessed the determinants of prenatal health care use. This article therefore aims to fill this gap. The objective of this study is to identify and analyze the determinants of prenatal health care utilization in Mali.

The rest of the document is organized as followings: the next section 2 presents the methodology; the results and discussion are presented in section 3 and section 4 concludes.

## 2. Methodological Approaches

### 2.1. Econometric Estimation

The objective of this paper is to estimate the factors affecting the use of antenatal care of women in rural areas in Mali; thus, in this study, the dependent variable takes into account two aspects; the first variable is dichotomous constructed to indicate whether or not the pregnant woman used the health services with the nursing staff. A logit model is needed to estimate the determinants of the use of antenatal care; by account the second variable is continuous and indicates the number of antenatal visits made by a woman to the nursing staff. Poisson and negative binomial models can help us estimate this endogenous variable.

The use of antenatal care is a binary variable that takes the value 0 if the woman did not use the health services before delivery and 1 if not. The objective is to analyze the factors likely to affect the use of antenatal care for women in Mali. As the use of antenatal care ( $Y$ ) is a qualitative dependent variable, the logit model is used. It explains the use or not of antenatal care knowing the characteristics of the woman and the household.

For the specification of the model, we consider a sample of  $N$  women of indices  $i = 1, \dots, n$ . for each woman  $i$ , we observe whether she used antenatal care or not and we obtain:

$$Y = \begin{cases} 1 & \text{if the woman to use antenatal care} \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Therefore, the use of antenatal care is given by the following function:

$$\text{logit } P(Y = j) = \beta_0 + \sum_{i=1}^n \beta_j X_i \quad (2)$$

Where  $X$  represents the characteristics of the woman and the household. In the logit model, the probability of occurrence of the event is the expectation of the variable  $Y$ .  $j$  takes the value 1 if the woman uses antenatal care and 0 if not.

The Poisson regression allows taking into account a conditional mean which is equal to the conditional variance and equivalent to the parameter  $\lambda$  which characterizes the model. The number of antenatal visits is given by  $y_i$  with  $i = 0, \dots, N$  for a sample of  $N$  individuals. The poisson regression model then specifies  $y_i$  since the values taken by the exogenous characteristics  $x_i$  as being distributed

according to the Poisson process with the density function:

$$f(y_i|x_i; \lambda) = \frac{\exp(-\lambda)\lambda^{y_i}}{y_i!} \quad (3)$$

Where  $\lambda_i = E[y_i/x_i] = Var[y_i/x_i] = \exp(x_i'\beta)$ .

This is the expected number of antenatal visits for any woman during her pregnancy. If the Poisson distribution is adequate, and assuming that we have a random sample  $y_i$  and  $x_i$ , the maximum likelihood procedure produces a consistent, asymptotically efficient and normal estimator of  $\beta$ .

Whereas, the equidispersion characteristic implies a restriction in the estimation, because generally, in economic data, like the use of health services (antenatal visits as proxy), the variance exceeds the average. This situation results from the heterogeneity of unobservable factors (heterogeneity of mothers' health states) across the sample and it is known as overdispersion [21]. Given the heterogeneity of mothers' health states, some women who know that they have often had complicated pregnancies, tend to have more antenatal visits than those without complications, which increases the variance. In this case, the poisson estimate is no longer desirable. An alternative solution then consists in applying the maximum likelihood to the negative binomial regression model which takes this overdispersion into account.

The negative binomial estimation is used as a mixed model which corrects the problem of overdispersion and the hypothesis of the generation process in the poisson model. This model was used by several authors such as [13, 14]. In this model, the distribution of  $y$  can be obtained as a component of the poisson process where the poisson distribution of the parameter  $\lambda$  is assumed to be generated according to a gamma law of mean equal to 1 [17]. The density function of the negative binomial regression model is obtained by:

$$f(y, \lambda, \zeta) = \frac{\Gamma(\zeta+y)}{\Gamma(\zeta)\Gamma(y+1)} \left(\frac{\zeta}{\zeta+\lambda}\right)^\zeta \left(\frac{\lambda}{\zeta+\lambda}\right)^y \quad (4)$$

Where  $\Gamma(a) = \int_0^\infty e^{-t} t^{a-1} dt$  is the density function of the gamma distribution,  $\zeta = (1/\alpha)\lambda^k$  is the precision of the parameter,  $k$  being a constant;  $\alpha > 0$  is the overdispersion of the parameter and  $\lambda_i = \exp(x_i'\beta)$ . With this specification, we obtain  $E[y_i/x_i] = \lambda_i$  and the variance is given by  $Var[y_i/x_i] = \lambda_i + \alpha\lambda_i^{2-k}$ . As before,  $\lambda$  is the expected number of antenatal visits for a given woman during her pregnancy, and  $\zeta$  is a dispersion parameter. However, we may want to proceed to model the probability of response of a count variable (or the counting variable) with more flexibility than in the previous models; in particular, we want to understand more the behavior of this probability in different parts of a distribution. There are alternative approaches to the above models, such as the « Hurdle », model, which in many applications is fixed to zeros. Here, the probability of response « zero » of the dependent variable and not correlated to the probability of response in the strictly positive part of the distribution.

## 2.2. Data Source and Description of Variables

The data used in this study come from the Multiple Indicator Cluster Surveys (MICS, 2015) carried out in Mali by INSAT (National Statistics Institute). The MICS survey is the second of its kind carried out within the framework of the fifth world cycle of the MICS program (MICS 5) and representative at the national level, collected from 12,460 selected households and distributed in 631 clusters of 30 households each in the region of Timbuktu, 25 in that of Gao and 20 in the other regions and the district of Bamako. Data collection was carried out from July 20<sup>th</sup> to October 21<sup>st</sup>, 2015. A total of 14,057 women were surveyed for 18,409 women aged 15-49. Data were collected from women on their reproductive history, fertility, use of health services, and children's health. In addition, the survey contains other socio-economic and demographic indicators at the household level.

Table 1. List of variables.

Dependent variable	Terms
Use of antenatal care during pregnancy	1 if the woman has performed antenatal care in the 2 years preceding the survey and 0 otherwise
Explanatory variables	
Age of woman	1 = 15 to 24 years; 2 = 25 to 34 years old; 3 = 35 to 49 years old
Marital status	1 = Currently married / in union; 2 = Formerly married / in union; 3 = never married / in union
Number of births	Number of children fertilized by a woman
Women's education level	1 = No education level; 2 = Primary; 3 = Secondary 1; 4 = Secondary 2 or more
Level of satisfaction with current income	1 = Very satisfied; 2 = Fairly satisfied; 3 = Neither satisfied; Neither dissatisfied; 4 = Quite dissatisfied; 5 = Very dissatisfied
Rural wealth index	1 = poorer; 2 = Poor; 3 = intermediate; 4 = rich; 5 = Richer
Contraceptive method	1=Yes 0=No

Source: Author's calculation, MICS data, 2015.

Table 2. Descriptive statistics.

Variables	Frequency	Percentage (%)	Use of antenatal care	
			Yes=12576	No=1481
Ages class				
15-24	4995	37.66	4494	501
25-34	4436	33.45	3751	685
35-49	3831	28.89	3536	295

Variables	Frequency	Percentage (%)	Use of antenatal care	
			Yes=12576	No=1481
Marital status				
Currently married / in union	11918	84.78	10491	1427
Formerly married / in union	297	2.11	278	19
Never married / in union	1842	13.1	1807	35
Rural wealth index				
Poorest	3741	26.61	3274	467
Poorer	2668	18.98	2324	344
Middle	2494	17.74	2184	310
Richer	2577	18.33	2346	231
Richest	2577	18.33	2448	129
Education				
No education level	10622	80.09	9257	1365
Primary	1414	10.66	1327	87
Secondary 1	838	6.32	811	27
Secondary 2 and more	388	2.93	386	2
Income satisfaction				
Has no income	2788	55.82	2498	290
Very satisfied	794	15.9	694	100
Quite satisfied	780	15.62	723	57
Neither satisfied nor dissatisfied	353	7.07	323	30
Quite dissatisfied	207	4.14	192	15
Very dissatisfied	73	1.46	64	9
Use of the contraceptive method				
Yes	1 417	12.21	1342	75
No	10189	87.79	8888	1301

Source: Author's calculation, MICS data, 2015.

Among the women surveyed, 89.5% used antenatal care services compared to 10.5%. The table 2 shows that 15 to 24 years old women mostly used health services and represent the highest segment of the surveyed population (37.66%). In terms of marital status, women currently married/in union are the highest (84.78%) and the lowest are women formerly married/in union with a rate of 2.11%. Regarding the rural wealth index, the poorest women are the majority (26.61%) and mostly use an antenatal care service, which suggests that accessibility to antenatal care is not an issue in rural areas. We also noticed that rural areas are dominated by uneducated women (80.09%) and as the level of education increases (primary to higher), the proportion of women decreases. Regarding the declaration of income satisfaction, the percentage of women with no income is 55.82%, followed by

those who say income is very satisfactory represents 15.9% and the lowest ratio is 1.46% when reporting very unsatisfactory income. Regarding the use of the contraceptive method, we observe that a few numbers of women use this method (12.21%) and among them, more than 1342 use antenatal care, this supposes that the use of contraceptive methods impacts positively the use of antenatal care.

### 3. Results

In this section, the estimation outcomes and discussions are presented. Table 3 presents the logit estimate of factors influencing the antenatal care demand. Then in next table 4, we present the results of the poisson models and the negative binomial.

**Table 3.** Result of the logit regression: modelling factors the antenatal care use.

Explanatory variables	Odds Ratio	Margins Effect
Woman's age	1.129	0.017
Woman's age square	0.994	-0.0007
Marital status (ref.: Never married / in union)		
Currently married / in union	0.236**	-0.205
Formerly married / in union	0.422***	-0.122
Rural wealth index (ref.: Poorest)		
Poorer	0.629**	-0.065
Middle	0.567***	-0.080
Richer	0.479***	-0.104
Richest	0.377***	-0.138
Education (ref.: No education level)		
Primary	0.493***	-0.100
Secondary 1	0.345***	-0.150
Secondary 2 and more	0.070***	-0.376

Explanatory variables	Odds Ratio	Margins Effect
Income satisfaction (ref.: Has no income)		
Very satisfied	1.305	0.037
Quite satisfied	0.626**	-0.066
Neither satisfied nor dissatisfied	0.638	-0.063
Quite dissatisfied	0.648	-0.061
Very dissatisfied	1.127	0.017
Use of the contraceptive method (ref.: No)		
Yes	0.321***	-0.161
Number of births	1.262***	0.033
Constant	0.563	
N	2365	
LR chi2(18)	209.81 (0.0000)	
Pseudo R <sup>2</sup>	0.0907	
Log likelihood	-1051.725	

Source: Author's calculation, MICS data, 2015, Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.00$ , \*  $p < 0.10$ .

Based on the results obtained above, all the variables associated with antenatal consultation of women are statistically significant at 1% and 5%, except the mother's age. The results show that mother's marital status influences significantly antenatal consultation at 1% and 5%. Indeed, women currently married/in union are more likely to use antenatal care than their counterparts who have never been married/in union. This result is similar for women who were previously married/in union. This could suggest that in Mali, marriage status is a determinant factor for antenatal care. The wealth index and use of antenatal care are statistically significant; the status of non-monetary poverty is also a determinant factor in the use of antenatal women in rural areas. This factor is not a constraint to the use of care services. These results corroborate those of [6] in Ethiopia. Regarding mother's level of education, women with primary, secondary and higher education level are more likely to use antenatal care compared to women with no education level. The

mother's education is statistically significant at 1% despite the small proportion of educated women. The education level can be a major fact in making decisions about seeking care. Furthermore, when addressing the level of income satisfaction, the estimation of the model produces interesting results. Women with fairly good income tend to have more antenatal care compared to their counterparts who report that their income is very satisfactory, neither satisfactory/unsatisfactory, fairly satisfactory/very unsatisfactory. When we refer to the use of contraceptive methods, the result shows that women who use contraceptive methods have a high probability for antenatal consultation. The marginal effect is negative and statistically significant at 1%. The number of births given by woman is an important part of the use of antenatal care. In this study, births number has a positive and significant effect on the probability of seeking antenatal care in rural Mali. This result could be explained by fertility experience and the need for health care in the pregnancy period of women.

**Table 4.** Results of Poisson and negative binomial estimates.

Explanatory Variables	Négative binomial		Poisson	
	Coef.	P_value	Coef.	P_value
Woman's age	-0.43	0.015*	-0.35	0.000***
Woman's square age	0.01	0.012*	0.009	0.000***
Marital status (ref.: Never married / in union)				
Currently married / in union	-0.73	0.004**	-0.78	0.000***
Formerly married / in union	-0.18	0.148	-0.18	0.001
Rural wealth index (ref.: Poorest)				
Poorer	0.28	0.003 **	0.27	0.000***
Middle	0.10	0.249	0.14	0.001**
Richer	-0.07	0.411	-0.07	0.094
Richest	0.15	0.097	0.17	0.000***
Education (ref.: No education level)				
Primary	0.03	0.650	0.065	0.059
Secondary 1	0.15	0.060	0.190	0.000***
Secondary 2 and more	0.39	0.004**	0.430	0.000***
Income satisfaction (ref.: Has no income)				
Very satisfied	0.07	0.335	0.104	0.003**
Quite satisfied	0.04	0.511	0.093	0.006**
Neither satisfied nor dissatisfied	0.01	0.877	0.052	0.270
Quite dissatisfied	0.39	0.001**	0.395	0.000***
Very dissatisfied	0.60	0.009**	0.617	0.000***

Explanatory Variables	Négative binomial		Poisson	
	Coef.	P_value	Coef.	P_value
Use of the contraceptive method (ref.: No)				
Yes	0.30	0.000**	0.29	0.000***
Number of births	-0.01	0.531	0.01	0.369
Constant	5.82	0.001	4.94	0.000
Number of observations	1303			
/lnalpha				-0.398
Alpha				0.671
LR test of alpha=0: chibar2(01) = 7190.74	Prob >= chibar2 = 0.000			

Source: Author's calculation, MICS data, 2015.

The estimated coefficients and their values in the negative binomial regression model show that there is a positive and significant correlation between the number of antenatal care visits and the poor rural wealth index, the income satisfaction level (very satisfied, somewhat satisfied), the use of contraceptive methods and higher education level as well as the woman's squared age. For poisson model, these same variables positively and significantly influence the number of antenatal visits. In brief, the factors affecting negatively and significantly the number of antenatal visits in the two models are woman's age and the marital status married/in union.

We find that the estimated effects of the variables in the two models are similar, except for variables such as satisfaction level and wealth index. For the binomial model, we find that whether a woman is currently married or in a union has a positive and significant effect on prenatal care use. Marital status plays an important role in prenatal care use decisions in developing countries [18]. Women from poor households have more access to antenatal care. Secondary 2 and higher levels of education have a positive and significant effect on antenatal care utilization. The age of the woman is negatively and significantly associated with the use of antenatal care while age squared has a positive and significant effect on the use of antenatal care.

For the fish model, women from poor, middle, and richer households have more access to antenatal care. For women with secondary 1, secondary 2, and tertiary education levels, the effect is positive and significant. Our results corroborate with those of [13] who showed that education level positively influences the number of ANC in Ivory Coast. Whether a woman belongs to a household with a very satisfied, fairly satisfied, fairly dissatisfied, very dissatisfied income level positively and significantly explains ANC use in Mali. This result of the wealth index is explained by the fact that health care use is not a concern for women but for their offspring.

## 4. Discussion

This study aims to identify the determinants of the use of antenatal care of women in rural areas in Mali. Three estimation techniques were used from data of Multiple Indicator Cluster Survey [12].

On the one hand, the results of the logit estimate allow us to identify that the marital status, the level of education, the rural wealth index, the use of the contraceptive method and the number of births are significantly associated with the use of

antenatal care among women living in rural areas. On the other hand, in the poisson model and the negative binomial model, the determinants of number of antenatal care visits are the poor rural wealth index, the level of income satisfaction (very satisfied, fairly satisfied), the use of contraceptive methods, the higher level of education and the woman age. The results showed that marital status had an impact on the use of antenatal care. Women who are currently married or formerly married were more likely to seek antenatal care than women who were never married. [15] The same results are found in Nigeria. The status of non-monetary poverty is also a determining factor in the use of antenatal care for women in rural areas. This factor does not constitute an obstacle to the use of care. These results corroborate with those of [6] in Ethiopia. Women's education level is positively and significantly associated with antenatal care. This result is consistent with studies made [16] in Ghana. The authors found that education level is a significant predictor of the use of antenatal care services. In addition, [4] shows that the level of education of women has a significant effect on the type of service choice of the relationship between access to paid employment for pregnant women and the use of modern health services is positive. [10] It's proved that the use of antenatal care is affected by a woman's education level in Jordan. The rural wealth index is positively and significantly associated with the number of antenatal cares. These results corroborate with those of [6] in Ethiopia and [13] in Ivory Coast. The results indicate that women who reported satisfactory income satisfaction have high probability of using health services. It has been reported that the likelihood of using antenatal care by women is explained by the use of contraceptive methods. Woman's age is significantly influencing the use of antenatal care. The number of births is likely to be correlated with the use of antenatal care. This result is similar to [8] those who found that the number of live births is significantly influenced by the use of antenatal care in Ethiopia.

## 5. Conclusion

This paper analyzes the socio-economic determinants of antenatal care use in rural area in Mali, using survey data from (MICS, 2015). Applying flat sorting, the results indicate that the majority of pregnant women in rural used antenatal care services (89.5%). Despite the high level of antenatal services used, certain factors constitute a major problem, such as the

level of education and marital status (single). The results of the logit model show that woman education level, wealth index and numbers of births are the major determinants of the use of antenatal care. In addition, the results of the poisson models and the negative binomial also indicate that the variables likely to affect the use of antenatal care are among others the poor rural wealth index, the income satisfaction level, the use of contraceptive methods and the high education level as well as woman age. On top of that research outcome, we suggest that it could be better to promote adequate use of antenatal care and necessary to promote the education of young girls. In short, it will be desirable that special attention be given to promoting a policy for mothers without any education, in order to make them aware of the need for optimal prenatal care.

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