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Modelling the Association of Maternal Factors on Exclusive Breastfeeding among Ghanaian women Using Logistic Regression and Bootstrapping Techniques

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Abstract This study examines the prevalence of exclusive breastfeeding among Ghanaian women and the determining factors associated with it. The study used a data set based on a longitudinal study from the fourth round of the Multiple Indicators Cluster Survey (MICS). This was a national survey conducted by Ghana Statistical Service (GSS) in 2011 to monitor progress of women and children. A sample of 10,963 women within the reproductive age (15 – 49) years across the country between 2009 and 2011 were selected for the survey. In this study, a multiple logistic regression and bootstrap techniques were used to determine the relationship of household/maternal factors and exclusive breastfeeding among children. The estimated children who were never breastfed exclusively for the first three days of life was about 15.8% out of the 2838 women who gave birth within the survey period. This means that a lot of mothers do not practice exclusive breastfeeding in Ghana. The factors observed to be highly significantly associated with exclusive breastfeeding among Ghanaian women included ethnicity (p-value = 0.019) and antenatal care (p-value = 0.031). The results show that exclusive breastfeeding among more advantaged women are more predominant than less advantaged women. The findings further reveal that exclusive breastfeeding is more of an ethnic and regional problem in Ghana which has some cultural undertone. There is need for the government to encourage mothers' secondary and above education. Massive public awareness and outreach programs need to include activities to fully engage community leaders and change agents on the dangers of failure to practice exclusive breastfeeding. Again, the ministry of Health should consider and come up with multifaceted program designs with clear, well-taught, understandable messages appropriate to the cultural context.

Keywords: *exclusive breastfeeding, prevalence, bootstrap, logistic*

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1. Introduction

Breastfeeding is an unequalled way of providing ideal food for the healthy growth and development of infants. It is also an integral part of the reproductive process with important implications for the health of mothers. Review of evidence has shown that, on a population basis, exclusive breastfeeding for 6 months is the optimal way of feeding infants. Thereafter infants should receive complementary foods with continued breastfeeding up to 2 years of age or beyond [5].

Breastfeeding for the first few years of life protects children from infection, provides an ideal source of nutrients, it is economical and safe [13]. However, many mothers stop breastfeeding too soon and there are often pressures to switch to infant formula, which can contribute to growth faltering and micronutrient malnutrition and is unsafe if clean water is not readily available.

To enable mothers establish and sustain exclusive breastfeeding for 6 months, WHO and UNICEF recommend the following:

1. Early initiation of breastfeeding within the first hour of life
2. Exclusive breastfeeding for the first six months – that is the infant only receives breast milk without any additional food or drink, not even water
3. Continued breastfeeding for two years or more
4. Breastfeeding on demand – that is as often as the child wants, day and night
5. No use of bottles, teats or pacifiers

Breast milk is the natural first food for babies, it provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one-third during the second year of life.

Breast milk promotes sensory and cognitive development, and protects the infant against infectious and chronic diseases [4,13]. Exclusive breastfeeding reduces infant mortality due to common childhood illnesses such as diarrhoea or pneumonia, and helps for a quicker recovery during illness. These effects can be measured in resource-poor and affluent societies (Kramer M et al Promotion of Breastfeeding Intervention Trial (PROBIT): A randomized trial in the Republic of Belarus. Journal of the American Medical Association, 2001, 285(4): 413-420).

Breastfeeding contributes to the health and well-being of mothers; it helps to space children, reduces the risk of ovarian cancer and breast cancer, increases family and national resources, is a secure way of feeding and is safe for the environment.

While breastfeeding is a natural act, it is also a learned behaviour. An extensive body of research has demonstrated that mothers and other caregivers require active support for establishing and sustaining appropriate breastfeeding practices. WHO and UNICEF launched the Baby-friendly Hospital Initiative (BFHI) in 1992, to strengthen maternity practices to support breastfeeding. The foundation for the BFHI is the Ten Steps to Successful Breastfeeding described in Protecting, Promoting and Supporting Breastfeeding: a Joint WHO/UNICEF Statement. The evidence for the effectiveness of the Ten Steps has been summarized in a scientific review document.

The BFHI has been implemented in about 16,000 hospitals in 171 countries and it has contributed to improving the establishment of exclusive breastfeeding world-wide. While improved maternity services help to increase the initiation of exclusive breastfeeding, support throughout the health system is required to help mothers sustain exclusive breastfeeding.

WHO and UNICEF developed the 40-hour Breastfeeding Counselling: A training course to train a cadre of health workers that can provide skilled support to breastfeeding mothers and help them overcome problems, both institutions have also developed a 5-day course on Infant and Young Child Feeding Counselling, to train health workers so they become competent and able to promote appropriate breastfeeding, complementary feeding and feeding of infants in the context of HIV.

Basic breastfeeding support skills are also part of the 11-day Integrated Management of Childhood Illness training course for first-level health workers, which combine skills for adequate case management with preventive care. Evaluation of breastfeeding counselling delivered by trained health professionals as well as community workers has shown that this is an effective intervention to improve exclusive breastfeeding rates. The Global Strategy for Infant and Young Child Feeding describes the essential interventions to promote, protect and support exclusive breastfeeding.

Exclusive breastfeeding as pointed out above refers to infants who receive only breast milk (and vitamins, mineral supplements, or medicine). According to the 2011 MICS approximately 46% of children less than six months are exclusively breastfed in Ghana, a level considered lower than that recommended by the WHO/UNICEF. There are also disparities among the various regions as well other socio-economic characteristics of the women in the country. Breast milk is nutritionally and immunologically superior to any known substitute. The World Health Organization (WHO), recognizing the importance of breastfeeding and in particular the well-known advantages of exclusive breastfeeding, recommends exclusive breastfeeding for 6 months as a global policy in order to achieve optimal maternal and infant health [5]. The Innocenti Declaration, which was adopted by the WHO and the United Nations Children's Fund (UNICEF), urges every government to develop national breastfeeding objectives and targets and consequently to establish a national system for monitoring progress [6,7]. Moreover, the WHO has developed definitions, indicators and methods for infant feeding patterns [8,9]. It seems that breastfeeding is well promoted according to the above recommendations, although national data on breastfeeding in general and exclusive breastfeeding in particular have been presented by very few countries [12]. Ghana, like many other countries, does not produce national data on breastfeeding or even local data based on standardized definitions. Moreover, the prevalence of exclusive breastfeeding in Ghana and the factors influencing the exclusiveness have not been thoroughly studied. It is for this purpose that we embarked on this study to find out the associated factors of exclusive breastfeeding among children in the first three days of life and its differentials within the country using both logistic regression and bootstrapping method.

2. Data

The 2011 Multiple Indicator Cluster Survey (MICS) data was used in this study. This is a fourth round of the survey which is conducted every five years to monitor the situation of children and women in Ghana. In this survey about 10,963 women who were within the reproductive age (15 – 49 years) were selected across the ten Regions of Ghana. The subjects were interviewed reference to two years preceding the survey. The selection procedure was based on a representative probability sample of households nationwide from a frame of Ghana 2010 Population and Housing Census Enumeration Areas (EA's). For comparability, the MICS used an internationally standardized sampling of two-stage stratified sample design. At the first stage, a number of EA's were selected from the regions which were considered as clusters. The households in each region were then selected using systematic sampling with probability proportional to size in the second stage. Of the 12,150 households selected for the sample, 11, 925 households were contacted and duly interviewed. In the households interviewed, 10,963 women aged 15 – 49 years were identified for interview

3. Methodology

The 2011 MICS was carried out on a sample of 11,925 households from a selected household of 11,970 in all the ten administrative regions of Ghana giving about 100%

response rate. The households were selected due to the sizes of the regions. The survey used both qualitative and quantitative methods of data collection aimed at providing basic data for measuring the progress of children and women in the country. Data used for analysis in this paper was based on information on all births and deaths that had occurred two years prior to the survey period. Statistical package for social scientists (SPSS version 20) and SAS system version 9.0 were used for extraction and the eventual analysis of data. Descriptive statistics and frequencies of the background characteristics of the mothers and the respective households the children belong to were generated. The association between the independent and dependent variable was established using chi-square analysis procedures. The dependent variable selected was the outcome of a question asked whether a child born alive in a household had been given anything to drink other than breast milk within first 3 days after delivery. The independent variables included children ever born, ethnicity, area of residence, antenatal care, region, economic status and mothers' characteristics including; education, religion and age. A critical level of significance of 5 percent ($p<0.05$) was used to identify the most statistically significant determinants of exclusive breastfeeding by mothers. Estimates of exclusive breastfeeding were obtained for the overall study regions

3.1. Model Specification

The following generalized linear logistic model was used

$$\pi = \log\left(\frac{u}{1-u}\right) = \chi\beta + \varepsilon \tag{1}$$

where π links the linear function to log $(\frac{u}{1-u})$. The link is not a linear function, μ is the probability of having exclusive breastfeeding and χ is the model matrix including antenatal care, mothers' educational level, age, ethnicity, religion, economic status of household and parity. The matrix also includes geographical location, such as region of origin and whether the respondent is from rural or urban environment; β is the vector of parameters, and ε is the vector of residuals. The Fisher scoring method was applied (SAS, 2007) to obtain Maximum Likelihood estimates of β. The overall goodness of fit is derived from the Likelihood Ratio Test of the hypothesis $H_{0:}$ c(β) = 0 where a comparison is made between the full model and the model that contains only the intercept (Hilbe and Greene, 2008). Therefore it is a test for global null hypothesis of the elements of the solution vector.

The odd of an event is the probability that it would happen to the probability that it would not occur and the likely number of times. In this paper it is the probability that a child will be exclusively breastfed to the probability that the child would not be exclusively breastfed. This means that the outcome variables in the logistic regression should be discrete and dichotomous. Logistic regression was found fit to be used because the outcome variable was in binary form that is a child is fed solely on breastmilk or otherwise. In addition, there were no assumptions to be made about the distributions of the explanatory variables as they did not have to be linear or equal in variance within the group. The model suggests that the likelihood of a particular household having an exclusively breastfeeding child varies across all the independent variables to be studied. After fitting the model, the outcomes were used to interpret the existing relationships between ones' child being on exclusive breastfeeding, household structure and mothers' characteristics.

3.2. Goodness of Fit Test

For basic inference about coefficients in the model the standard trinity of Likelihood-based tests, Likelihood ratio, Wald and Lagrange Multiplier (LM), are easily computed. For testing a hypothesis, linear or nonlinear, of the form;

$$H_{0:} c(\beta) = 0 \tag{2}$$

The likelihood-ratio statistic is the obvious choice. This requires estimation of β subject to the restrictions of the null hypothesis, for example subject to the exclusions of a null hypothesis that states that certain variables should have zero coefficients. That is, they should not appear in the model. Then the likelihood-ratio statistic;

$$X^2[J] = 2(logL - \log L_0) \tag{3}$$

where $logL$ is the log-likelihood computed using the full or *unrestricted* estimator, $logL_0$ is the counterpart based on the restricted estimator and the degrees of freedom *J*, the number of restrictions. Each predictor, including the constant, can have a calculated Wald Statistic defined as

$$\left[\beta_j \,/\, SE\left(\beta_j\right)\right]^2, \tag{4}$$

which is distributed a X^2. $[\beta_j / SE(\beta_j)]^2$ defines both the z or t statistic, respectively distributed as t or normal. For computation of Wald Statistics, one needs the asymptotic covariance matrix of the coefficients.

3.3. Bootstrap Techniques

The bootstrap method has the advantage of modeling the impacts of the actual sample size. It is important to note that the results based upon the bootstrapping method do not necessarily negate the results yielded from the conventional test when the two results are different from each other. Instead, the discrepancy just sends a warning to the researcher that the results may not be stable, and thus the issue under investigation remains inconclusive. This skeptical attitude is encouraged especially when the statistical inferences would influence crucial decision-making. For example, in a sociological study on the situational factors of risky sexual behaviors among college students, in which privacy and freedom of students may be affected by certain policy changes, Apostolopoulos, Sonmez and Yu employed the bootstrapping approach in addition to classical tests. Whenever there is a sign that stability of the results is in question, further investigations should be encouraged.

3.3.1. Theoretical Support

To understand bootstrap, suppose it were possible to draw repeated samples (of the same size) from the population of interest, a large number of times. Then, one would get a fairly good idea about the sampling distribution of a particular statistic from the collection of its values arising from these repeated samples. But, that does not make sense as it would be too expensive and defeat the purpose of a sample study. The purpose of a sample study is to gather information cheaply in a timely fashion. The idea behind bootstrap is to use the data of a sample study at hand as a **"surrogate population"**, for the purpose of approximating the sampling distribution of a statistic; i.e. to resample (with replacement) from the sample data at hand and create a large number of **"phantom samples" known as bootstrap samples**. The sample summary is then computed on each of the bootstrap samples (usually a few thousand). A histogram of the set of these computed values is referred to as the bootstrap distribution of the statistic.

In bootstrap's most elementary application, one produces a large number of "copies" of a sample statistic, computed from these phantom bootstrap samples. Then, a small percentage, say $100(\alpha/2)\%$ (usually α = 0.05), is trimmed off from the lower as well as from the upper end of these numbers. The range of remaining 100(1- α)% values is declared as the confidence limits of the corresponding unknown population summary number of interest, with level of confidence 100(1-α)% . The above method is referred to as bootstrap percentile method.

In terms of mathematical notations, suppose a population parameter θ is the target of a study; say for example, θ is the household median income of a chosen community. A random sample of size n yields the data $(X_1, X_2, \ldots, X_n)$. Suppose, the corresponding sample statistic computed from this data set is $\hat{\theta}$ (sample median in the case of the example). For most sample statistics, the sampling distribution of $\hat{\theta}$ for large n ($n \geq 30$ is generally accepted as large sample size), is bell shaped with centre θ and standard deviation$(a/\sqrt{n})$, where the positive number a depends on the population and the type of statistic $\hat{\theta}$. This phenomenon is the celebrated Central Limit Theorem (CLT). Often, there are serious technical complexities in approximating the required standard deviation from the data. Such is the case when $\hat{\theta}$ is sample median or sample correlation. Then bootstrap offers a bypass. Let $\hat{\theta}_B$ stand for a random quantity which represents the same statistic computed on a bootstrap sample drawn out of $(X_1, X_2, \ldots, X_n)$. What can we say about the sampling distribution of $\hat{\theta}_B$ (w.r.t. all possible bootstrap samples), while the original sample $(X_1, X_2, \ldots, X_n)$ is held fixed. The first two articles dealing with the theory of bootstrap – Bickel and Freedman (1981) and Singh (1981) provided large sample answers for most of the commonly used statistics. In limit, as $(n \to \infty)$ the sampling distribution of $\hat{\theta}_B$ is also bell shaped with $\hat{\theta}$ as the centre and the same standard deviation $(a/\sqrt{n})$, Thus, bootstrap distribution of $\hat{\theta}_B - \hat{\theta}$ approximates (fairly well) the sampling distribution of $\hat{\theta} - \theta$. Note that, as we go from one bootstrap sample to another, only $\hat{\theta}_B$ in the expression $\hat{\theta}_B - \hat{\theta}$ changes as $\hat{\theta}$ is computed on the original data $(X_1, X_2, \ldots, X_n)$. This is the bootstrap Central Limit Theorem. For a proof of bootstrap CLT for the mean, see Singh.

Furthermore, it has been found that if the limiting sampling distribution of a statistical function does not involve population unknowns, bootstrap distribution offers a better approximation to the sampling distribution than the CLT. Such is the case when the statistical function is of the form $(\hat{\theta}_B - \hat{\theta})/SE$ where SE stands for true or sample estimate of the standard error of $\hat{\theta}$ in which case the limiting sampling distribution is usually standard normal. This phenomenon is referred to as the second order correction by bootstrap. A caution is warranted in designing bootstrap, for second order correction. For illustration, $Let\ \theta = \mu$ the population mean, and $\hat{\theta} = \bar{X}$ the sample mean; σ = population standard deviation, s = sample standard deviation computed from original data and s_B is the sample standard deviation computed on a bootstrap sample. Then, the sampling distribution of $(\bar{X} - \mu)/SE$, with $SE = \sigma/\sqrt{n}$, will be approximated by the bootstrap distribution of $\overline{(X_B} - \bar{X})/\widehat{SE}$, with $\bar{X}_B$ = bootstrap sample mean and $\widehat{SE} = s/\sqrt{n}$.

3.3.2. Bootstrap-t Methods

As has been stated early on, bootstrapping a statistical function of the form $T = (\hat{\theta} - \theta) / SE$ where SE is a sample estimate of the standard error of θ, brings extra accuracy. This additional accuracy is due to so called one-term Edge-worth correction by the bootstrap. The reader could find essential details in Hall (1992). The basic example of T is the standard t - statistics (from which the name bootstrap- t is derived): $t = (\bar{X} - \mu)/(s/\sqrt{n})$, which is a special case with $\theta = \mu$ (the population mean), $\hat{\theta} = \bar{X}$ (the sample mean) and s standing for the sample standard deviation. The bootstrap counterpart of such a function T is $T_B = (\hat{\theta}_B - \hat{\theta})/SE_B$ where SE_B is exactly like SE but computed on a bootstrap sample. Denote the 100s-th bootstrap percentile of $T_B$by b_s and consider the statement: T lies within $[b_{.025}, b_{.975}]$. After the substitution $T = (\hat{\theta} - \theta) / SE$, the above statement translates to 'θ lies within $(\hat{\theta} - SE b_{.975}, \hat{\theta} - SE b_{.025})$'. This range for θ is called bootstrap-t based confidence interval for θ at coverage level 95%. Such an interval is known to achieve higher accuracy than the earlier method, which is referred to as "second order accuracy" in technical literature.

We end the section with a remark that B. Efron proposed correction to the rudimentary percentile method to bring in extra accuracy. These corrections are known as Efron's "bias correction" The details could be found in Efron and Tibishirani. The bootstrap-t automatically takes care of such corrections, although the bootstrapper needs to look for a formula for SE which is avoided in the percentile method.

4. Results

The percentage of children who had been given anything to drink other than breast milk within first 3 days after delivery was about 16 (15.8% from our sample of non-missing weights). This figure is quite staggering and indicates a public health concern and especially as this is just a figure for the first three days of life. We speculate that few mothers will practice exclusive breastfeeding which covers a 6 months period. Table 1 provides a descriptive view of the different categories. Children in rural settings are less likely to undergo exclusive breastfeeding compared with those in urban settings (about 73.5% versus 26.5%). At the regional levels, the northern, central and Upper East regions have high rates compared to other regions. Thus these regions have high number of children were not exclusively breastfed. %). The highest coming from northern region with about 26.7% followed by Central with about 16.3% and Upper East with 12.0%. Ashanti region follows fourth with a prevalence of 10.5%. Volta region has the least prevalence rate of about 2.2% in the country. Surprisingly, mothers who receive antenatal care services are less likely to practice exclusive breastfeeding than their counterparts who do not receive antenatal care (about 93.8% against 6.2%). Children from rural households, those from the poorest households and those whose mothers have no education or a maximum of middle/JHS school education are more likely than more advantaged children not to be breastfed exclusively. For example, the proportion of unexclusive breastfeeding children whose mothers have a maximum of middle/JHS education is 82.6%, compared to 17.4% of children whose mothers have a minimum of secondary school education. Children from Akan and Mole Dagbani origin are likely not to undergo exclusive breastfeeding compared to those in among other ethnic groups (68.4% versus 31.6%). Children born in wealthiest households are more likely to have exclusive breastfeeding compared to children from poorest households. The possibility of children not enjoying exclusive breastfeeding is predominant among first time mothers and those who have a least five children. Again middle age mothers are less likely to exclusively breastfeed their children compared to other women. We speculate again that these women be involved in economic activities that may not allow them to practice exclusive breastfeeding.

Table 2 and Table 3 depict the results of multivariate logistic analysis and the bootstrap parameter estimates of the factors associated with anaemia respectively. The factors observed to be highly significantly associated with anaemia included ethnicity (p-value=0.019) and antenatal care (p-value=0.031). Table 3 confirms the significance or otherwise of the variables understudied as evidenced by the two-tailed test and biases associated with it. Confounder control by multiple logistic regression analysis revealed that significance factors (in order of odds ratio) were ethnicity and antenatal care.

(feedback from reviewers) Please add – comment.

5. Discussion

The 15.8% prevalence of non-exclusive breastfeeding among children within the first three days of life in Ghana found in this study is quite high and paints a gloomy picture. This is so because the estimated figure for six months is much higher than the WHO cut-off point of 40% making it a serious public health concern. The descriptive statistics show that children born in urban areas are more likely to undergo exclusive breastfeeding than rural children. Again, children born to women who have higher education tend to undergo exclusive breastfeeding than children whose mothers are not educated or have low levels of education. Households whose economic status is high also tend to practice exclusive breastfeeding than those who live below the poverty line. Children born of Akan or Mole Dagbani background are less likely to be exclusively breastfed compared to children born of any other ethnic background. The age of a mother determines the extent of breastfeeding among Ghanaian children. Middle level women are less likely to exclusively breastfeed their babies compared with women in other categories. Parity and antenatal care services are major determining factors for exclusive breastfeeding among children in Ghana. The association of the variables especially antenatal care, economic status and mothers' educational level observed in this study has also been reported from other developed and developing countries. The non-exclusive breastfeeding prevalence of 15.8% among children within the first three days which is higher than the WHO threshold is a source of worry to the nation as it indicates a public health problem. The risk of a child being breastfed exclusively was higher among households with poor economic status, children born of women with no or low education, women of Akan or Mole Dagbani ethnic background, middle level women, living in the northern part of the country or central region, first time mothers or women who have at least five children and surprisingly women who received antenatal care services.

6. Conclusion

Attaining the anticipated 2015 Millennium Development Goal 4 is highly impossible with the prevailing high infant and under five mortality estimates which has some relationship with breastfeeding. Breast milk promotes sensory and cognitive development, and protects the infant against infectious and chronic diseases. Exclusive breastfeeding reduces infant mortality due to common childhood illnesses such as diarrhoea or pneumonia, and helps for a quicker recovery during illness. This paper delved into exploring the effect of household characteristics on exclusive breastfeeding among babies within first three days of life. Findings show wide breastfeeding differentials by mother's age, place/region of residence, parity and level of education. Antenatal care and ethnicity were the two major variables highly associated with exclusive breastfeeding.

Basing on the findings, it is imperative that the government together with other development partners, including policy makers, programme managers to design programs that will directly sensitize people on the need and importance of practising exclusive breastfeeding especially in northern part of the country as well as central region. There is need for the government to encourage mothers' secondary and above education. Massive public awareness and outreach programs need to include activities to fully engage community leaders and change agents on the dangers of failure to practice exclusive breastfeeding. Exclusive breastfeeding exercise that was started by Ghana Health Service must be given a further boost especially among the Akan and Mole Dagbani communities and for any community support for breastfeeding to succeed; there must be supportive action by the health system. Again, the ministry of Health should consider and come up with multifaceted program designs with clear, well-taught, understandable messages appropriate to the cultural context.

This is further linked with antenatal care services hence pregnant mothers should be educated on the need for antenatal and post-natal care services in order that they can appreciate the need and benefits for exclusive breastfeeding. Health providers must also constantly highlight on the need of exclusive breastfeeding when mothers attend antenatal and post-natal care. The government should further elevate mothers economically so that they can provide the basic requirements for themselves and their children.

Table 1. Descriptive characteristics of the study population

Variable	Child given anything to drink other than breast milk within first 3 days after delivery		Total
	Yes N (%)	No N (%)	N (%)
Residence			
Urban	119 (26.5)	664 (27.8)	783 (27.6)
Rural	330 (73.5)	1725 (72.2)	2055 (72.4)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Region			
Western	37 (8.2)	134 (7.4)	171 (6.0)
Central	73 (16.3)	306 (23.0)	379 (13.4)
Greater Accra	35 (7.8)	119 (6.0)	154 (5.4)
Volta	10 (2.2)	130 (7.2)	140 (4.9)
Eastern	14 (3.1)	120 (7.3)	134 (4.7)
Ashanti	47 (10.5)	126 (9.6)	173 (6.1)
Brong Ahafo	33 (7.3)	117 (7.1)	150 (5.3)
Northern	120 (26.7)	621 (12.4)	741 (26.1)
Upper East	54 (12.0)	307 (7.9)	361 (12.7)
Upper West	26 (5.8)	409 (12.0)	435 (15.3)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Wealth index quintiles (Economic status)			
Poorest	196 (43.7)	1114 (34.3)	1310 (46.2)
Second	101 (22.5)	466 (23.6)	567 (20.0)
Middle	49 (10.9)	337 (20.5)	386 (13.6)
Fourth	54 (12.0)	264 (13.4)	318 (11.2)
Richest	49 (10.9)	208 (8.2)	257 (9.1)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Antenatal care (ANC)			
Received	421 (93.8)	2326 (51.7)	2747 (68.8)
Did not Receive	28 (6.2)	63 (31.1)	91 (22.2)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Ethnicity			
Akan	158 (35.2)	585 (24.5)	743 (26.2)
Ga/Dangwe	24 (5.3)	69 (2.9)	93 (3.3)
Ewe	20 (4.5)	194 (8.1)	214 (7.5)
Guan	16 (3.6)	91 (3.8)	107 (3.8)
Gruma	50 (11.1)	226 (9.5)	276 (9.7)
Mole Dagbani	149 (33.2)	950 (39.8)	1099 (38.7)
Grusi	17 (3.8)	150 (6.3)	167 (5.9)
Mande	7 (1.6)	54 (2.3)	61 (2.1)
Non-Ghanaians	6 (1.3)	46 (1.9)	52 (1.8)
Others	2 (0.4)	24 (1.0)	26 (0.9)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Children ever born			
1	101 (22.5)	386 (16.2)	487 (17.2)
2	65 (14.5)	398 (16.7)	463 (16.3)
3	67 (14.9)	402 (16.8)	469 (16.5)
4	53 (11.8)	344 (14.4)	397 (14.0)
≥5	163 (36.3)	859 (36.0)	1022 (36.0)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Age			
15-19	33 (7.3)	121 (5.1)	154 (5.4)
20-24	88 (19.1)	367 (15.4)	455 (16.0)
25-29	86 (19.2)	608 (25.4)	694 (24.5)
30-34	121 (26.9)	560 (23.4)	681 (24.0)
35-39	66 (14.7)	447 (18.7)	513 (18.1)
40-44	40 (8.9)	211 (8.8)	251 (8.8)
45-49	15 (3.3)	75 (3.1)	90 (3.2)
Total	***449 (100)***	***2389 (100)***	***2838 (100)***
Educational level			
JHS and below	200 (82.6)	978 (83.3)	1178 (83.1)
Secondary school +	43 (17.4)	196 (16.7)	239 (16.9)
Total	***243 (100)***	***1174 (100)***	***1417 (100)***

Table 2. Logistic regression model

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Antenatal care	-.920	.426	4.676	1	.031	.398	.173	.917
Educational level	-.129	.072	3.223	1	.073	.879	.763	1.012
Ethnicity	.051	.022	5.541	1	.019	1.052	1.009	1.098
Religion	-.001	.005	.014	1	.905	.999	.990	1.009
Region	.010	.033	.102	1	.750	1.011	.948	1.078
Locality	-.157	.183	.736	1	.391	.855	.597	1.223
Wealth index quintiles	.045	.073	.382	1	.536	1.046	.907	1.207
Constant	2.115	.749	7.969	1	.005	8.293		

Table 3. Bootstrap model for parameters

	B	Bootstrap[a]				
		Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Antenatal care	-.920	.017	.449	.021	-1.746	.023
Educational level	-.129	.005	.077	.082	-.274	.036
Ethnicity	.051	.003	.022	.031	.016	.099
Religion	-.001	.000	.005	.908	-.009	.010
Region	.010	-.003	.036	.785	-.063	.076
Locality	-.157	.000	.176	.391	-.500	.182
Wealth index quintile	.045	.001	.074	.558	-.098	.196
Constant	2.115	-.056	.720	.004	.578	3.464

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples (feedback from reviewrs).

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