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Antenatal care services utilization and maternal birth outcomes among pregnant women in Wa municipality

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Abstract

It remains unclear if the benefits of antenatal care can be attributed to the amount and content of care received during pregnancy. Understanding the effects of antenatal care services utilisation on the maternal birth outcome is enormous. This is because the pathways through which the effects are obtained remain elusive. The study assessed the effects of antenatal care services utilization on maternal birth outcomes among pregnant women in the Wa Municipality. The study employed a retrospective cohort design. The study used the probability proportionate to size sampling to select the sub-district health catchment facilities while systematic random sampling was used to select respondents. Data was collected from 353 women based on the status of ANC utilization. The results revealed that educational status, maternal knowledge on the adequacy of 4+ ANC, score for general services received, number of Tetanus (TT) doses received and anaemia status at ANC registration were significant predictors of adequate ANC utilization in the study area. The prevalence of preterm deliveries and low birth weight were 36.3% and 7.1% respectively. Additionally, inadequate utilization of ANC, exposure to smoking and not receiving education on health and nutrition on possible danger signs and complications in pregnancy were predictors of preterm deliveries while Anaemia at 36 weeks gestation and exposure to smoking predicted low birth weight. The study concludes that inadequate ANC service utilisation is positively associated with to low and preterm births. The study recommends policies and initiatives that would increase maternal education on the health benefits of antenatal care with an emphasis on the pre-disposing risk factors such as smoking on birth outcomes.

Keywords: Antenatal, Maternal Health, Birth Outcomes, Preterm Births, Service Utilisation, Pregnancy

1. Introduction

Antenatal care (ANC) services remain one of the Safe Motherhood interventions if properly implemented in Ghana. This is because it has the potential to significantly reduce maternal and prenatal mortalities (Oladapo & Osiberu, 2009) [19]. ANC interventions have been found to enhance maternal and newborn health, which can also impact the survival and health of the mother and the infant (Bullough *et al*., 2005) [11]. The antenatal period presents opportunities for reaching pregnant women with interventions to maximize maternal and neonatal health (Simkhada *et al*, 2008) [24]. ANC also provide opportunities for pregnant women to make appropriate and informed choices and contribute to optimum pregnancy outcome and improved care of the newborn (Baffour-Awuah *et al*., 2015) [7]. In high-income countries, virtually all pregnant women have at least four antenatal care visits, are attended to by a skilled health worker during childbirth and receive postpartum care. In contrast, in 2015, only 40% of all pregnant women in low-income countries had the recommended antenatal care visits (WHO, 2019). A study in Kenya indicated that 52.5% of women in rural areas and 49.2% in urban settings attended ANC once prior to delivery with the first ANC visit after 28 weeks of pregnancy (Delva *et al*., 2010) [13].

In Ghana, 85% of pregnant women attended at least one antenatal care visit with a skilled provider before delivery. Seventy-three percent of pregnant women in urban areas and 55% in rural areas were more likely to attend 4 or more antenatal visits (Overbosch *et al*, 2004; Piaggio *et al*., 1998) [21, 22]. However, a survey by the Ghana Statistical Service (2014) showed that 97% of women in Ghana receive antenatal care from a skilled provider with almost no mothers receiving ANC from a traditional birth attendant. And only 3 percent of mothers received no ANC for their most recent birth in the five years before

the survey (Ghana Statistical Service, 2014). This is in contrast to an earlier report that indicated that up to 40% of pregnant women in developing countries receive no ANC (Adamu & Salihu, 2002) [2] and in Ghana, 14% of women did not attend ANC at all (Overbosch *et al*, 2004) [21]. The median duration of pregnancy for the first antenatal visit is 3.6 months (Ghana Statistical Service, 2014). Expectedly, the percentage of deliveries occurring in a health facility has also increased from 42 percent in 1988 to 73 percent in 2014. Also, the percentage of births attended by a skilled provider has increased from 40 percent to 74 percent over the same period (Ghana Statistical Service, 2014). This reaffirms a study that showed that in some developing countries, far more women are seen by health workers during pregnancy than are delivered by a trained attendant. (Carroli *et al*, 2001) [12]. In light of evidence from a 2001 systematic review (Carroli *et al*., 2001) [12], the World Health Organization (WHO) began promoting a new model of ANC for low-income countries, moving away from the traditional model known as "the focused antenatal care".

Despite these interventions, efforts to monitor progress in coverage of antenatal care have generally focused on quantifiable issues such as the number and timing of visits and the characteristics of users and non-users of antenatal care. However, understanding the effects of antenatal care services utilisation on birth outcomes such as preterm births and birth weights (Abou-Zahr and Wardlaw, 2003) [1] have received less attention. In practice, indicators of use are easier to define, measure and interpret than indicators for access. Indicators on the use of antenatal care services provide no information on the content or quality of the services. Despite the broad consensus on what the content and quality should be, it is generally recognized that the antenatal care services currently provided in many parts of the world fail to meet the standards recommended by the World Health Organisation (Abou-Zahr and Wardlaw, 2003) [1]. The World Health Organization (WHO) recommended that pregnant women in developing countries should seek ANC within the first three months of pregnancy (Abou-Zahr *et al*., 2003) [1]. All pregnant women should have at least four antenatal care (ANC) assessments by or under the supervision of a skilled attendant. These should, as a minimum, include all the interventions outlined in the new WHO antenatal care model and be spaced at regular intervals throughout pregnancy, commencing as early as possible in the first trimester (WHO, 2016). Thus, for a pregnant woman to have attained adequate antenatal care utilization, she should have initiated her first ANC visit within her first trimester and in addition, attended three or more subsequent ANC visits. Otherwise, if a pregnant woman initiates her first ANC visit after her first trimester or even initiates her first ANC visit within her first trimester and fails to make up to the three minimum subsequent visits, she is considered to have inadequate ANC utilization. Even though the current WHO ANC model guideline stipulates a minimum of eight ANC contact visits with the first equally occurring in the first trimester in order to be considered adequate (WHO, 2016), little is known in literature about the effects of ANC on birth outcomes such as preterm deliveries and low birth weight. This study thus employed a cross sectional survey design to examine the influence of antenatal care services utilisation on maternal birth outcomes among pregnant women in Wa Municipality of the Upper West Region of Ghana.

2. Review of related literature

Adverse birth outcomes such as prematurity, anaemia, preterm births, stillbirths, low birth weight and birth defects represent significant problems in both developing and developed countries. Each year, about 15 million babies in the world, more than one in 10 births, are born too prematurely, Kannaujiya (2020) [17]. More than one million of those babies die shortly after birth; countless suffer from lifelong physical, neurological, or educational disabilities, often at great cost to families and societies (Blencowe *et al*., 2013; Howson *et al*, 2013) [18, 16]. In Ethiopia, the adverse outcomes of pregnancy are still major public health problems (Andargie *et al*, 2013; Berihun *et al*, 2012) [4, 8]. There is wide recognition that one of the major factors contributing to the high rate of adverse birth outcomes is the low use of prenatal and maternal health services (Bilenko *et al*., 2007; Fotso *et al*., 2009) [9, 14]. There is substantial evidence in the medical literature linking both short (typically less than 18 months) and long (more than 5 years) inter-pregnancy intervals to adverse infant health outcomes, (Kannaujiya *et al*. 2020 [17]; WHO & UNICEF, 2004; Katz *et al*. 2013 [18]).The birth outcome indicators these studies measured include infant mortality, stillbirth, preterm delivery, and low birth weight. Smits and Essed (2001) [25] and Van Eijsden *et al*. (2008) [26] suggested nutritional depletion in particular folate as a mechanism through which short spacing might affect birth outcomes. On the other hand, the "physiological regression hypothesis" proposes that after long intervals, women's reproductive capabilities regress (Zhu *et al*., 1999) [32]. Provision of micronutrient supplements especially iron and folic acid during early pregnancy and if possible before conception is among the strongly recommended interventions. It is well known that folate deficiency in early pregnancy is associated with congenital malformations such as neural tube defects and increased DNA damage. Besides such birth defects, babies of mothers with folate deficiency are more likely to be small for gestational age, delivered pre-term, develop sever language delay and even are at high risk for mortality (Furness, Dekker, & Roberts, 2011; Ossa *et al*., 2012 [20]; Prathapan *et al*., 2011; Roth *et al*., 2011 [23]). A study by Yatich *et al*. in 2006 revealed a 44.6% prevalence of adverse pregnancy outcomes among pregnant women in Kumasi could be a result of barriers associated with accessing ANC services. However, a follow-up study conducted amongst pregnant women who presented themselves for delivery at selected public hospitals and private traditional birth attendants from July–November 2011 in Kumasi observed a low prevalence (19%) of adverse pregnancy outcomes. The outcome indicators measured included low birth weight, stillbirth and preterm delivery or small for gestational age. The difference in the results could be due to the introduction of the National Health Insurance Scheme (NHIS) in 2003. Additionally the changes made to the antenatal protocol in 2005 which came into full effect in 2011could have accounted for the low prevalence of adverse pregnancy outcomes (Asundep *et al*., 2013; Yatich *et al*., 2010) [5, 30]. A study by Asunder *et al* showed that women with >5 births had an increased likelihood of an adverse outcome compared with women with single deliveries. Also, women 36 years or older with a primary level of education or no formal education were more likely to experience an adverse outcome. Additionally, having 2 or more children was significantly associated with a woman experiencing an

adverse outcome (Asundep *et al*., 2013) [5]. The achievement of Millennium Development Goal (MDG) 4 is strongly influenced by progress in reducing neonatal deaths. Since preterm birth is the leading cause of neonatal mortality, the progress of MDG-4 is dependent on achieving high coverage of evidence-based interventions that halt preterm deliveries and improve survival for preterm new-borns. As a result, epidemiological data on the magnitude and risk factors of adverse birth outcomes are important for planning maternal and child health care services in developing countries (Adane *et al*., 2014) [3].

3. Methodology

The paper adopted a retrospective cohort design. The study used quantitative techniques to collect data that answer the research questions. Both Open and closed ended questionnaires were administered to the participants. This research was conducted in the Wa Municipality of the Upper West Region of Ghana. The study population consisted of all women who had attended antenatal care in the Municipality and delivered within the past 12 months in a health facility preceding the study. The sample size was calculated using a Two Sample Situations formula as follows:

$$n = D\left[(Z\alpha + Z\beta)^2 * (P_1(1-P_1) + P_2(1-P_2)/P_1 - P_2)^2\right] \quad (1)$$

Where:-

D = design effect which is normally 2 as a default value

P_1 = the estimated level of an indicator measured as a proportion at the time of the first survey or for the control area, which is the current anaemia prevalence of 42% = 0.42

P_2 = the expected level of the indicator either at a future date is 21% = 0.21

Zα = the Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size (P1 – P2) would not have occurred by chance (α - the level of statistical significance).

Zβ = the z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size (P2 - PI) if one actually occurred (statistical power).

This implies that,

D= 2, Zα= 1.960 at 95% confidence level, Zβ= 1.645 at 0.95 statistical power, P_1= 0.42 and P_2= 0.21

Hence,

$$n = 2\left[(1.96+1.645)^2 * (0.42(1-0.42) + 0.21(1-1.21)/0.42-0.21)^2\right] \quad (2)$$

$$n = 2[12.996 * 0.244 + 0.166/0.0441] = 2[75.669] = 151.338 = 152 \quad (3)$$

Probable loss to follow up of 10% of sample = 16

Hence the sample size per one category = 152+16 = 168

This gave a minimum sample size of 336. However, the maximum sample size of 353 women was interviewed where 176 attained adequate ANC and 177 attained inadequate ANC.

3.1 Inclusion criteria

All women who had attended ANC in Wa Municipality and delivered within 12 months preceding the study in a health facility and possessing a maternal health booklet/record for the index pregnancy.

3.2 Exclusion criteria

This exclusion criteria are:

- Referred women from other districts' ANC facilities who came and delivered in the Wa Municipality;
- women who attended ANC elsewhere for the most part of their pregnancy;
- Women who never attended ANC; and
- Women with no maternal health records or booklet for their index pregnancy.

3.3 Sampling procedure

The Wa Municipality has been subdivided into six (6) Sub-Municipals with a total of 26 government health facilities including Community-based Health Planning and Services (CHPS) and 4 private facilities. However, there are 22 active government and 4 private health facilities that offered Antenatal Care (ANC). The entire six (6) sub-districts of the Wa Municipality were represented with the corresponding sub-district health catchment facilities selected using probability proportionate to size sampling technique. The procedure is based on the total ANC registrants gotten from the current twelve-monthly aggregates from the DHIMS 2 database. This was to determine the individual facility catchments from which the respondents would be chosen in the sub-district. In all, 14 of the municipality's 45 facilities were selected because they have provided ANC services from across government and non-governmental health institutions within the period under study. Systematic random sampling was then used to draw respondents from the facilities' ANC register based on the status of ANC utilization until the estimated sample size of 353 was achieved. Selected participants were then linked up and followed to their households at the community level for the interview.

3.4 Data collection tools and procedure

The tools used to collect the data are a pre-coded structured and semi-structured questionnaire and an observation checklist. Data was collected through face-to-face interviews with respondents using a pre-coded structured and semi-structured questionnaire, after getting consent. Pre-testing of the questionnaire was done by randomly selecting women from the ANC register of a few health facilities in the Wa Municipality and tracing them to their households for the interview. The main purpose of the pre-test was to ensure readability and comprehension of the questions and the feedback was used to correctly revise the questionnaire to provide the desired answers. This guaranteed the validity of the tool which was used for the data collection in the study. The trained research assistants thus gained competency and administered the questionnaires the right way and this guaranteed reliability of the research tool. The questionnaire had 59 items captioned under seven sub-titles; Status of ANC services utilization, Personal information/demographic characteristics, Records review of maternal ANC booklet or card, Anthropometric and biochemical assessment, Content and quality of ANC services, Maternal behaviours and health status during last pregnancy, Socioeconomic household wealth index of the respondent. Information on the seven sub-titles on the questionnaire that needed to be answered by the respondents

was duly captured whereas those that were needed from the maternal ANC booklet/card were also reviewed accordingly and captured.

3.5 Data processing and analysis

The quantitative data were manually entered using the Statistical Package for Social Science (SPSS) version 21. Data were cleaned by running preliminary frequencies of all the variables to check for entry inaccuracies. All incorrectly coded data were double-checked with the questionnaire after which all wrong entries were corrected. After the data cleaning, descriptive statistics are performed and the results were presented in percentages, frequencies and tables. Analytically, chi-square tests were used to measure associations between the dependent and independent variables while logistic regressions were also used to determine the actual predictors of the independent variables to the dependent variables of interest. The logistic regression adjusted odds ratio (AOR) and 95% confidence intervals were used to assess the strength of association for all the statistically significant associations with a p-value <0.05.

3.6 Variable classification

In this study, the dependent variables were: a) pre-termed deliveries; b) birth weight; and c) gestational age at delivery. The independent variables are: a) socio-demographic and socio-economic characteristics; b) components of received ANC including a general score of services received; c) maternal reproductive health and obstetric profile; and d) maternal knowledge and behavioural risk factors. The independent variables are categorical as; adequate or inadequate ANC utilization, 28 weeks gestation, 36 weeks gestation, socio-demographic included characteristics like maternal age at ANC registration, educational status, religion, marital status, occupational status and wealth index. Components of received ANC involved weight checking, height measurement, blood pressure was taken, blood and urine sample examination, received education on possible danger signs/complications of pregnancy, received TT injection, SP and monthly iron supplementation, fundal height measurement and palpation. Others include receiving information assistance on childhood diseases, maternal and child nutrition, breastfeeding, antenatal and delivery care, vaccinations and immunizations, and family planning as well as the number of TT and SP doses received. The overall score for services received and score for received information was categorised as low or high for each whereas that of the TT and SP received was categorised as adequate or inadequate. Maternal reproductive health and obstetric profile included high or low-risk gravidity, high or low-risk parity, adequate or inadequate birth spacing, late or early gestational age at registration and number of ANC attendance. On maternal knowledge and behavioural risk factors, characteristics such as knowledge on making 4+ ANC visits including ANC Services importance, smoking exposure, alcohol intake, episodes of malaria infection, and dietary diversity score were recorded.

4. Descriptive Statistics

In this section, we used descriptive statistics to present the data and also test relationship between the independent and dependent variables using chi-square and regression analysis.

4.1 Demographic and Socioeconomics Characteristic of Respondents

Of the three hundred and fifty-three (353) total study respondents in the survey, it was observed that an overwhelming majority (85.0%) were Waala/Dagaaba and the remaining 15.0% constituted the minor ethnic groups. However, in descending substantial order among the minority ethnic groups, Sissalas followed by Dagomba/Mamprusis, and Ashanti/Fantis were quite notable tribes in the Wa Municipality. The remaining very few, however, are a mix of other Ghanaian and foreign tribes such as upper easterners (Frafra and Kasena/Builsas), Gonjas, Bimoba, Konkonbas, Burkinabes, Niger, etc.

In terms of religious background of respondents, the study revealed that the municipality is predominantly a muslim dominated municipality because 84.4% of the respondent indicate Islam as their religion and the remaining being Christians according to the results.

In terms of marital status, almost all the respondents (91.2%) were duly married whereas the remaining few were not married. The results also indicate that about one-third of the study participants (36.3%) never had any formal education. A sizeable proportion (39.9%) of the respondents had attained at most first-cycle education (primary and junior high). However, very few respondents (23.8%) were able to attain at least a second-cycle education (senior high and tertiary levels).

The study observed that about 38.0% of the respondents were unemployed. Out of this, many are housewives and few are on an apprenticeship in various works such as hairdressing, dressmaking or weaving and very few as students. At the time of this study, only 8.2% of the respondents were engaged as government/private employees. And 53.8% of the respondents were into self-occupation either as farmers or as traders in cooking/brewing and selling, buying and selling of commodities. Concerning birth spacing, the study shows that 48.2% and 26.9% of the respondents conceived after the youngest child had attained at least three years of age and less than three years respectively. Also, the study revealed that about one-fourth of the respondents were primiparas who had never delivered. On the household wealth index classification, most of the respondents were above the median wealth index while 43.9% were below the median.

4.2 Maternal reproductive health and ANC utilization records and birth outcomes

The respondents' ages at ANC registration ranged from 15 to 58 years. Greater than half of the respondents (77.3%) were between 20 – 34 years old whilst about one-eighth were 35+ years old with the remaining being adolescents.

Concerning the number of previous pregnancies, most of them were at low risk with less than gravida five and only 12.7% were at high risk with gravida five plus. Similarly, with the number of previous deliveries/births, very few (7.9%) and most (92.1%) of the respondents were at high and low risks respectively in the face of five plus parity and less than parity five. Also, it was realised that close to two-thirds of the mothers practised adequate birth spacing with a minimum of three years inter-child spacing whilst the remaining 26.9% practised inadequate spacing with less than three years inter-child birth spacing. Slightly more than half of the respondents initiated early and timely ANC

attendance within the first trimester of their pregnancy whilst close to half (48.7%) initiated late ANC attendance after the first trimester. In contrast, the percentage in the total number of ANC visits by the respondents was found to be 80.7% of 4+ as against 19.3% with less than four visits. The implication is that about one out of every five ANC women will likely attain less than the recommended four-plus visits in the Wa Municipality (Table 1).

Table 1: Maternal reproductive health and ANC utilization records

Variable		Frequency	Percent
Age of mother at registration	Under 20 years	28	7.9
	20-34 years	273	77.3
	At least 35 years	52	14.7
	Total	353	100.0
Score for Gravidity			
	Low risk	308	87.3
	High risk	45	12.7
	Total	353	100.0
Score for Parity level			
	Low risk	325	92.1
	High risk	28	7.9
	Total	353	100.0
Birth Spacing			
	Inadequate	95	26.9
	Adequate	258	73.1
	Total	353	100.0
Gestational age at registration			
	Early registration	181	51.3
	Late registration	172	48.7
	Total	353	100.0
No. of ANC Attendance			
	<4 visits	68	19.3
	4+ visits	285	80.7
	Total	353	100.0

Source: Author's computation

4.3 Antenatal Care utilization and Birth Outcomes

The records (Table 2) equally showed that most (63.7%) of the women had full-term (37weeks plus) deliveries and the rest had pre-term (less than 37weeks) deliveries. In addition, the majority of the women (85.8%) underwent spontaneous vaginal delivery and the rest were delivered through caesarean section and vacuum extraction at birth. Of the total deliveries, aside from a mother who was delivered of a macerated stillbirth occurring from a twin delivery (1 live and 1 stillbirth), all the others were delivered of live births. Likewise, almost all the women had single deliveries and only 3.4% of them had multiple/twin deliveries. Nevertheless, all 365 children were delivered both live and stillbirth with a sex ratio of almost 1:1. Also, the overall low birth weight (less than 2.5 Kg) was 7.1% amongst the total children born with a higher prevalence among the second twin deliveries (25%) than from among the single deliveries (6.5%). Similarly, of the 365 babies born, only 77.5% had their birth lengths taken with 9.5% having an inadequate birth length of less than 46cm. However, there is a slightly higher prevalence in the second twin deliveries (11.1%) than amongst the first single deliveries (9.5%) in terms of inadequate birth length.

Table 2: Frequency of birth outcomes

Variable		Frequency	Percent
Gestational age at delivery			
	<37 weeks	128	36.3
	37+ weeks	225	63.7
	Total	353	100.0
Delivery Mode			
	SVD	303	85.8
	CS	49	13.9
	Vacuum extraction	1	.3
	Total	353	100.0
Birth Outcome status			
	Live Birth	352	99.7
	Both	1	.3
	Total	353	100.0
Single or Multiple Delivery			
	Single	341	96.6
	Multiple Delivery	12	3.4
	Total	353	100.0
Sex of Baby 1			

	Male	178	50.4
	Female	175	49.6
	Total	353	100.0
Birth Weight1			
	<2.5kg	23	6.5
	>=2.5kg	330	93.5
	Total	353	100.0
Birth Length of Baby 1			
	Less than 46cm	26	7.4
	46+ cm	248	70.3
	Total	274	77.6
Missing	System	79	22.4
Total		353	100.0
Sex of Baby 2			
	Male	6	1.7
	Female	6	1.7
	N/A	341	96.6
	Total	353	100.0
Continuation of frequency of birth outcomes			
Birth Weight2		**Frequency**	**Percent**
	<2.5kg	3	.8
	>=2.5kg	9	2.5
	N/A	341	96.6
	Total	353	100.0
Birth Length of Baby 2			
	Less than 46cm	1	.3
	46+ cm	8	2.3
	Total	9	2.5
Missing	System	344	97.5
Total		353	100.0

Source: Author's Computation

4.4 Empirical Results

4.4.1 Relationship of factors with gestational age at delivery among pregnant women

The results indicated that of all the suspected factors, the status of ANC utilization, gestational age at ANC registration, exposure to smoking and received education on health and nutrition on possible danger signs and complications in pregnancy were the only statistically significant in association with preterm deliveries (Tables 3). However, there was a weak association between the number of TT and SP doses received and gestational age at delivery (Table 3). With ANC utilization (χ^2 (1, N = 353) = 7.275, p = 0.007) women who had inadequate utilization were more likely (43.2%) to deliver preterm than their counterparts with inadequacy (29.4%). On gestational age at ANC registration (χ^2 (1, N = 353) = 7.505, p = 0.006) women who register early are more likely (43.1%) to deliver preterm than those with late registration. Regarding women who had received education on possible danger signs and complications in pregnancy (χ^2 (1, N = 353) = 4.400, p = 0.036) women who did not receive any such education were more (40.4%) likely to deliver preterm than their colleagues who received. Also, on smoking exposure (χ^2 (1, N = 353) = 8.135, p = 0.004), it was realised that women who were exposed to smoking were more (59.4%) likely to deliver preterm than those not exposed.

Table 3: Relationship of factors with Preterm deliveries

Variable	**Gestational age at delivery, n (%)**		**n = 353**		
			Test statistic		
	< 37 weeks	**37+ weeks**	**df**	**χ^2**	***P-value***
ANC utilization					
Adequate	76 (43.2)	100 (56.8)	1	7.275	0.007
Inadequate	52 (29.4)	125 (70.6)			
Ethnicity					
Major	116 (36.7)	200 (63.3)	1	0.262	0.609
Minor	12 (32.4)	25 (67.6)			
Religion					
Muslim	107 (35.9)	191 (64.1)	1	0.104	0.747
Christian	21 (38.2)	34 (61.8)			
Education					
No education	43 (33.6)	85 (66.4)	2	1.495	0.474
Low education	50 (35.5)	91 (64.5)			
High education	35 (41.7)	49 (58.3)			
Marital status					
Married	125 (36.2)	220 (63.8)	1	0.005	Fisher 1.000
Not Married	3 (37.5)	5 (62.5)			

Occupation					
No occupation	56 (41.8)	78 (58.2)	2	3.263	0.196
Self-employed	64 (33.7)	126 (66.3)			
Gov't/Private employee	8 (27.6)	21 (72.4)			
Wealth index					
Low	54 (34.8)	101 (65.2)	1	0.242	0.623
High	74 (37.4)	124 (62.6)			
Birth spacing					
Inadequate	27 (28.4)	68 (71.6)	1	3.456	0.063
Adequate	101 (39.1)	157 (60.9)			
Age of mother at registration					
Under 20 years	15 (53.6)	13 (46.4)	2	4.308	0.116
20 – 34 years	93 (34.1)	180 (65.9)			
>= 35 years	20 (38.5)	32 (61.5)			
Gestational age at registration					
Early	78 (43.1)	103 (56.9)	1	7.505	0.006
Late	50 (29.1)	122 (70.9)			
Hb at ANC registration					
Anaemic	52 (34.7)	98 (65.3)	1	0.491	0.484
Normal	74 (38.3)	119 (61.7)			
Received nutrition & health education on danger signs					
No	90 (40.4)	133 (59.6)	1	4.400	0.036
Yes	38 (29.2)	92 (70.8)			

Source: Author's Computation

4.5 Determinants of preterm births (Multiple logistic regression)

The results (Table 4) show that women who had inadequate utilization of ANC were 2.2 times [(AOR, 2.211; 95% CI (1.389 – 3.519), p=0.001] more likely at risk of delivering preterm than their counterparts with adequacy. In addition, women who did not receive education on health and nutrition on danger signs/complications of pregnancy were observed to be 79.6% [(AOR, 1.796; 95% CI (1.106 – 2.917), p=0.018] more likely to be at risk of delivering preterm babies compared to those who received the education. Similarly, women exposed to smoking were 3.1 times [(AOR, 3.106; 95% CI (1.441 – 6.697), p=0.004] more likely to be at risk of delivering preterm babies compared to those not exposed.

Table 4: Multiple logistics regression of predictors of preterm births

Variables in the Equation						
	B	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)	
					Lower	Upper
Adequate ANC utilization (Reference)						
Inadequate ANC utilization	0.793	11.187	0.001	2.211	1.389	3.519
Not receive education on health & nutrition on danger signs/complications (Reference)						
Received education on health & nutrition on danger signs/complications	0.586	5.610	0.018	1.796	1.106	2.917
Not exposed to smoking (Reference)						
Exposed to smoking	1.133	8.361	0.004	3.106	1.441	6.697
Constant	-1.466	32.101	0.000	0.231		

*Cox and Snell R square= 0.063 *Nagelkerke R square= 0.086 *Model Chi-square= 22.794 *Hosmer and Lemoshow test = 0.902

4.6 Relationship of factors with birth weight among pregnant women

Using the same independent variables as in Table 5 including gestational age at delivery in running the cross-tabulation analysis, gestational age at delivery, Hb status at 36 weeks gestation and exposure to smoking were the only statistically significant in association with birth weight (Table 26). On gestational age at delivery (χ^2 (1, N = 353) = 11.807, p = 0.001) women delivering at preterm were more (12.5%) likely to have low birth weight babies than those at full term (3.1%). Regarding Hb status at 36 weeks gestation (χ^2 (1, N = 177) = 5.185, p = 0.023, Fisher= 0.029) anaemic women at 36 weeks were less likely (2.2%) to deliver low birth weight babies than those not anaemic at 36 weeks (10.5%). Also, on exposure to smoking (χ^2 (1, N = 353) = 13.629, p < 0.001) exposed women were more (21.9%) likely to deliver low birth weight babies than those not exposed (5.0%). However, there was also a weaker association between birth weight and women with blood pressure taken at least thrice (χ^2 (1, N = 353) = 3.973, p = 0.046, Fishers = 0.069) and score for gravidity (χ^2 (1, N = 353) = 3.595, p = 0.058, Fishers= 0.056).

Table 5: Associated factors with Low-birth-weight deliveries

Variable	Birth weight, n (%)				
			Test statistic		
	< 2.5 kg	2.5+ kg	df	χ^2	*p-value*
Gestational age at delivery					
<37 weeks	16 (12.5)	112 (87.5)	1	11.807	0.001
37+ weeks	7 (3.1)	218 (96.9)			
Hb at 36 weeks					
Anaemic	2 (2.2)	89 (97.8)	1	5.185	0.023
Normal	9 (10.5)	77 (89.5)			Fisher=0.029
Smoking exposure					
Yes	7 (21.9)	25 (78.1)	1	13.629	0.000
No	16 (5.0)	305 (95.0)			

4.7 Determinants of low birth weights (logistic regression)

Women who were anaemic at 36 weeks of gestation were 88.4% less likely to be protected against giving birth to low-birth-weight babies as compared to those not anaemic at week 36 of gestation. Comparatively, women exposed to smoking were 31.6 times [(AOR, 31.612; 95% CI (6.488-154.027), p<0.001] more likely to be at risk of delivering low birth weight babies than those not exposed.

Table 6: Multiple logistics regression of predictors of low birth weights

Variables in the Equation						
	B	Wald	Sig.	Exp (B)	95% C.I. for EXP(B)	
					Lower	Upper
Normal (Reference)						
Anaemic at 36 weeks gestation	-2.154	5.441	0.020	0.116	0.019	0.709
Not exposed to smoking (Reference)						
Exposed to smoking	3.454	18.270	0.000	31.612	6.488	154.027
Constant	-2.823	35.785	0.000	0.059		

*Cox and Snell R square= 0.131 *Nagelkerke R square= 0.353 *Model Chi-square= 24.925 *Hosmer and Lemoshow test = 0.540

5. Discussion

In many low-and middle-income countries (LMIC) without wide-scale vital registration, no nationally representative data are available on rates of preterm birth. Substantial investment and attention are required to improve vital registration systems and to account for all birth outcomes (Blencowe *et al*., 2013 [18]; WHO, 2011). In the meantime, the amount of population-based data available in high-burden countries could be dramatically increased to better inform future estimates and monitor time trends if data on preterm birth rates were able to be included in nationally representative surveys such as the Demographic and Health Surveys (DHS). This will require developing, testing and training in the use of preterm-specific survey-based tools which are not currently available. Understanding the role of prenatal care in birth outcomes is still a challenge because the pathways through which the effects are obtained remain elusive (Barros *et al*., 1996). Some studies found little relationship between the utilization of prenatal care, namely as expressed by the timing and number of visits, and rates of low birthweight (Alexander, 1987; Gortmaker, 1979; Korenbrot *et al*., 1994). Similarly, another study showed the number of visits alone was not associated with preterm birth but in contrast, a significant association was found between the content and timing of care and preterm birth (Beeckman *et al*., 2018). Mixed results came from programmes that have to date tested the benefits of preventive interventions for preterm birth, with some showing important reductions and others showing no benefit at all (Buescher *et al*., 1988; McCormick, 1985). These findings led researchers to consider as modest the overall relationship between prenatal care and better pregnancy outcome. But it is not clear what factors associated with prenatal care explain the observed benefits. That is if the results can be attributed to the amount and content of care or to uncontrolled risk factors that might also affect the use of care (Barros *et al*., 1996). In France, women who attended for less than four visits or who started care in the last 3months of pregnancy were at higher risk of preterm birth compared with those who attended more visits or who started care earlier (Blondel *et al*., 1998). Also according to Barros *et al*, compared with mothers who received inadequate prenatal care, a significantly decreased crude risk of preterm was found for those with adequate (OR = 0-20, 95 per cent CI 012-0-32) or intermediate care (OR = 0-35, 95 per cent CI 0-23-0-54) (Barros *et al*., 1996).

From this study, women who had inadequate utilization of ANC were 2.2 times [(AOR, 2.211; 95% CI (1.389 – 3.519), p=0.001] more likely to be at risk of delivering preterm than their counterparts with adequacy. Consistent with this study literature, women who are late or have no prenatal care at all are more likely to have low birth weight and/or preterm birth and they are at increased risk of pregnancy and childbirth-related morbidity and mortality (Barros *et al*., 1996; Raatikainen *et al*., 2007). Whereas Adane *et al* (2014) [3] found preterm prevalence in their study to be 14.3% in Gondar University Hospital (Adane *et al*., 2014) [3], another Ethiopian study showed that the overall proportion of LBW and preterm births were 9.1% and 13.6% respectively. Women with inadequate or low dietary diversity score (DDS) had a 2-fold risk of LBW (ARR: 2.06; 95% CI: 1.03, 4.11) and a 4.7-fold higher risk of preterm births (ARR: 4.61; 95% CI: 2.31,9.19) than women in the adequate group (Zerfu *et al*, 2016). However, in this study, the proportion of LBW and preterm births were 6.5% and 36.3% respectively for the first singleton deliveries. But there was not any statistically significant association between DDS and LBW (χ^2 (1, N = 353) = 0.292, p = 0.589) and preterm births (χ^2 (1, N = 353) = 1.874, p = 0.171) even though it showed

women with low DDS were at higher risks of 52.2% and 51.6% respectively more than those with high DDS. This observed difference of preterm proportions to this study is strongly consistent with a study that showed the reported proportion of preterm births that were provider-initiated ranged from 20% in Sudan to nearly 40% in 51 facilities in Latin America and a teaching hospital in Ghana (Alhaj *et al*., 2010; Barros, FC., 2006; Ip *et al*., 2010; Nkyekyer *et al*., 2006). The findings of this study further indicated that aside from the status of ANC utilization, exposure to smoking and not receiving education on health and nutrition on possible danger signs and complications in pregnancy were also factors statistically significant in association with and predictors of preterm deliveries.

Smoking and excessive alcohol consumption as well as periodontal disease also have been associated with an increased risk of preterm birth (Gravett *et al*., 2010; Reedy, 2007). It was found in this study that women exposed to smoking were 3.1 times [(AOR, 3.106; 95% CI (1.441 – 6.697), p=0.004] more likely to be at risk of delivering preterm babies compared to those not exposed. This conforms to many other studies that showed an increased risk of preterm births for smoking exposed women relative to unexposed women (Grantz *et al*., 2015; Gravett *et al*., 2010; Reedy, 2007).

Again, this study found that women who did not receive education on health & nutrition on danger signs/complications of pregnancy were observed to be 79.6% [(AOR, 1.796; 95% CI (1.106 – 2.917), p=0.018] more likely to be at risk of delivering preterm babies compared to those who received the education. A cross-tabulation analysis from this study between receiving education on health & nutrition on danger signs/complications of pregnancy and ANC utilization showed a stronger association (χ^2 (1, N = 353) = 9.799, p = 0.002). This indicates a reverse causality as women who received education on health & nutrition on danger signs/complications of pregnancy were more (60.8%) likely to attain adequate ANC compared to those who received no education.

Regarding low birth weight (LBW) in this study, preterm delivery, anaemia at 36 weeks gestation and exposure to smoking were the factors statistically significant in association with birth weight (Table 26). However, only anaemia at 36 weeks gestation and exposure to smoking were the predictors of low birth weight. This is contrary to Katz *et al* finding that the primary causes of LBW are preterm birth, intrauterine growth restriction (IUGR), or a combination of the two (Lancet, 2013) [18]. The linkage between these primary causes by Katz *et al* and associated factors of LBW in this study is due to reduced levels of haemoglobin that favour changes in placental angiogenesis and limit the availability of oxygen to the foetus. Thus causing potential restriction of intrauterine growth and low birth weight (Stangret *et al*., 2017).

It has been established from several studies that pregnant women with anaemia are at higher risk of having low birth weight children compared with women who do not have anaemia during pregnancy (Figueiredo *et al*., 2018; Rahman *et al*., 2016). This agrees with the findings of this study where women who were anaemic at 36 weeks of gestation were 88.4% less likely to be protected against giving birth to low birth weight babies as compared to those not anaemic at week 36 of gestation. Even though maternal anaemia in the third trimester according to Rahmati *et al* has no significant relationship with low birth weight (Rahmati *et al*., 2016) they observed that maternal anaemia in the first trimester showed a significant relationship with low birth weight (Rahmati *et al*., 2016). From this study, women anaemic at ANC registration were about 6.3 times [(AOR, 6.266; 95% CI (3.039 – 12.923), p<0.001] more likely to also be at risk of being anaemic at 36 weeks of gestation compared to those not anaemic at registration and this could perhaps influence the observed low birth weights among women with anaemia at 36 weeks gestation.

According to Barry *et al*, maternal characteristics such as cigarette smoking was significantly associated with the occurrence of low birthweight (Barros *et al*., 1996). This is also true for this study where women exposed to smoking were 31.6 times [(AOR, 31.612; 95% CI (6.488-154.027), p<0.001] more likely to be at risk of delivering low birth weight babies than those not exposed. As an association, Adane *et al* established that LBW was more common in women who had a previous history of preterm and/or small baby deliveries and among preterm newborns (Adane *et al*., 2014) [3]. This is consistent with this study too (χ^2 (1, N = 353) = 11.807, p = 0.001) as women delivering preterm were more (12.5%) likely to have low birth weight babies than those at full term (3.1%).

6. Conclusion and recommendations

The prevalence of preterm deliveries and low birth weight were 36.3% and 7.1% respectively. This when compared with other studies is relatively high perhaps due to a miscalculation of gestational age at registration. Again, from the findings of this study, inadequate utilization of ANC, exposure to smoking and not receiving education on health and nutrition on possible danger signs and complications in pregnancy were predictors of preterm deliveries. Regarding birth weight, anaemia at 36 weeks gestation and exposure to smoking were the predictors of low birth weight. The Content and Timing of care in Pregnancy (CTP) tool measures preterm birth in a better way compared with all other measures. Hence to evaluate whether improved antenatal care use results in a reduction of preterm births, health policymakers will need adequate data recording that can contribute to effective quality control measures and using the CTP tool may help decision-makers in their choice of what data should be collected in the future (Beeckman *et al*., 2018). Due to possible recall bias of LMP and miscalculation of exact gestational age assessment, the 'best obstetric estimate' and the gold standard of using routine early ultrasound assessment together with foetal measurements ideally in the first trimester is recommended over the use of LMP alone (Blencowe *et al*., 2013) [18]. The study concludes that inadequate utilization of ANC, exposure to smoking and pregnant women not receiving education on health and nutrition on possible danger signs and complications in pregnancy were predictors of preterm deliveries while Anaemia at 36 weeks gestation and exposure to smoking predicted low birth weight. The study recommends policies and initiatives that would increase maternal education on the health benefits of antenatal care with an emphasis on the pre-disposing risk factors such as smoking on birth outcomes.

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8. Conflict of interest statement

The authors declared that there is no conflict of interest in this research.

9. Author contributions

Dr. William Angko conceived the study and wrote the introduction. Dr Joseph Kwame Wulifan wrote the literature review section of the paper. Dr. William Angko wrote the methods and did the estimation. Dr. Amos Dangbie Dordah did the writing and discussion of the results. All authors read the final paper and approved it.

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