Original Research Article

Risk and Protective factors associated with Hypertensive Disorders in Ghana: The case of the Bolgatanga Regional Hospital of the Upper East Region

ABSTRACT

Aim: The goal of this study was to identify some risk and protective factors associated with hypertensive disorders among pregnant women in the Bolgatanga Regional Hospital of Ghana's Upper East Region.

Study Design: This study is a one case-control study design.

Place of Study: The study was conducted in the Antenatal clinic and Maternity ward of the Upper East Regional hospital in Bolgatanga.

Methodology: The study population consisted of pregnant women who were attending their antenatal care at the Bolgatanga regional hospital whose gestational ages were more than 20 weeks.
Hundred (100) study participants were selected using the purposive sampling technique (a non-probability sampling technique). Data for the study was gathered from the history of the 100 pregnant women who were visiting the Bolgatanga Regional Hospital for antenatal care. The analysis was conducted using the logistic regression model of STATA 14.

Results: The study disclosed that white blood cells (WBC), low-density lipoprotein cholesterol (LDL), placenta weight (PW), gestational weight (GW), body mass index (BMI) were statistically significant. BMI was discovered to have a positive association with hypertensive disorders (*OR= 2.208, P= .025*), whereas PW (OR=0.994, *P= .085*), GW (*OR=0.815, P=.079*), WBC (*OR=0.719, P=.01*), and LDL (*OR=0.645*, *P= .027*) were discovered to have negative associations with hypertensive disorders (odds ratios less than one).
Conclusion: The study identified BMI as a risk factor and PW, GW, WBC, and LDL as protective factors. On the basis of the analysis it was recommended that health professionals should raise the awareness of women on the risks of hypertensive disorders even before they become pregnant, especially maintaining healthy weight.

Keywords: *Blood Pressure, Gestational hypertension, Gravidity, Parity, Body Mass Index, Cholestrol, Odds Ratio*

1. INTRODUCTION

Hypertension is high blood pressure (HBP) that occurs because of force exerted by the blood pressure against the walls of the blood vessels with pressure reading of more than 140/90mmHg. Gestational hypertension (GH) is a condition which affects pregnant women globally. This normally sets in after 20 weeks of conception. Between 5 and 10% of all pregnancies in connection with haemorrhages and infections are attributed to pregnancy induced hypertension. This leads to maternal mortality and

morbidity which are risk factors for both mother and child health wise. No therapeutic agents have been developed to prevent or cure hypertension in pregnancy for reasons that there is little or absence of a complete understanding of the pathogenesis of this disease. Nonetheless, several abnormalities or complications develop as the pregnancy develops and these have been observed clinically to aid in the causation and progress of Pregnancy induced hypertension, with the involvement of glucose, cholesterol and mother's gravida status.

Due to the substantial incidence of maternal and perinatal adversity associated with hypertensive disorders in pregnancy (HDP), there is still a significant therapeutic problem in modern obstetric practice, Duley [1] and National Institute for HealthCare Excellence, [2]. According to Singh, [3], one of the main causes of maternal and perinatal mortality is gestational hypertension and can also result to chronic hypertension, kidney failure, and neurological abnormalities. Gestational hypertension, sometimes referred to as pregnancy-induced hypertension (PIH), occurs when a pregnant woman develops new hypertension after 20 weeks of pregnancy without the appearance of protein or other pre-eclampsia signs, McGraw-Hill Professional [4].

According to a study published in The Lancet Global Health [5], obstetric causes accounted for 73% of all maternal deaths that occurred between 2003 and 2009, while indirect causes contributed to 27.5% of all fatalities and hypertensive illnesses were responsible for 14% of deaths.

Pre-eclampsia has a number of known risk factors, including null parity, obesity, pre-existing hypertension, a history of the condition in the past or in the family, current autoimmune conditions, and extremes in maternal age, even though the exact etiology of the condition is unknown. Globally, the condition causes 500,000 child fatalities and 70,000 maternal deaths each year Sibai [6] and Khan et al. [7], with more than half of all deaths, sub-Saharan Africa (SSA) is thought to be the region most severely affected, Alkema et al. [8].

Despite improvements in perinatal care, hypertensive disorders of pregnancy, which affect 5–10% of all pregnancies, continue to be a major cause of maternal and fetal sicknesses Lindheimer & Katz, [9]. Studies conducted across the globe, according to Palacios & Pena-Rosas, [10], revealed that 10% of pre-eclampsia pregnancies are complicated by pregnancy-induced hypertension, and that about 9.1% of motherly deaths in Africa are brought on by pregnancy-related hypertensive diseases. The majority (99%) of maternal deaths occur in developing nations, with more than half occurring in sub-Saharan Africa, where 1 in 180 pregnant women die after childbirth, compared to 1 in 4,900 in affluent nations, raising serious concerns about maternal mortality.

Pre-eclampsia affects 2-8% of all pregnancies globally, accounting for nearly one-third of all maternal deaths as well as more than 6 million perinatal deaths and 8 million preterm births, according to studies by Ahman & Zupan [11], Beck et al., [12], Steegers, et al. [13] and Lozano et al. [14].

Pre-eclampsia, one of several hypertension disorders of pregnancy, has been reported by the World Health Organization (WHO) to have a negative influence on mother and newborn health with no proven cure other than ending the pregnancy or expelling the fetus WHO, [15].

Despite the fact that pre-eclampsia has recently acquired attention, it wasn't until the late 1800s that a relationship between high blood pressure, edema, and proteinuria and eclampsia was established that it was discovered to be significant Lindheimer & Katz, [9]. Although the pathophysiology was not entirely known, it was believed to be related to early pregnancy-related placental disruption, which was followed by inflammation and progressive damage, [15]. Pregnancy-related hypertension complications may have an impact on both the mother and the fetus. The fetus may experience preterm delivery, respiratory distress syndrome, and fetal growth restriction, while the mother may experience neurological sequelae, renal failure, or liver failure Tate & Bushnell, [16].

The most typical medical issue related to pregnancy is hypertension Saudan et al. [17]. According to Meazaw, et al. [18] and Antwi et al. [19], pregnancy induced hypertension is also the main cause of maternal and perinatal illness and mortality which happens in 3% to 10% of all pregnancies. One of the top five main causes of maternal and newborn fatalities in Ghana is the prevalence of hypertension during pregnancy Der et al. [20]. Additionally, Osei-Nketiah [21] discovered that hypertensive pregnancies were one of the four main risk factors linked to 40% of maternal mortality in Ghana. According to Owiredu, et al. [22], pregnancy induced hypertension is responsible for 9% of maternal fatalities in Ghana. Increasing maternal age has also been linked to an increased risk of hypertension during pregnancy. Both women age 35 or older and women between the ages of 13 and 16 were discovered to be at risk for pregnancy-related hypertension Bilano, et al. [23].

According to studies conducted by Fondjo, et al [24], in Ghana, Pregnancy-Induced-Hypertension is one of the commonest cause of pregnancy complications with 7.0% incidence rate of pre-eclampsia.
Prevention of hypertension during pregnancy in Ghana faces a number of challenges including the delay in seeking medical attention after recognizing its signs, as well as the lack of awareness of risk factors connected to it. Fondjo, et al.[25].
However in the Bolgatanga Hospital, where this study was conducted, there is no data available on Pregnancy-Induced-Hypertension, hence, the reason for conducting this study at the Bolgatanga Regional Hospital in view of the fact that it is also a referral hospital by using the Logistic Regression Model of STATA 14.

2. Materials and Methods

2.1 Study Area

This study is a one case-control study which was conducted in the Upper East Regional hospital in Bolgatanga. The study population consisted of pregnant women who were attending their antenatal care at the Bolgatanga regional hospital whose gestational ages were more than 20 weeks.
Study participants were selected using the purposive sampling technique (a non-probability sampling technique) and a sample of hundred (100) pregnant women were selected.

2.2 Data Collection Procedure

Data for the study was collected by midwives who were recruited from the hospital and trained by the Navrongo Health Research Institute. Face-to-face interviews using the pre-tested questionnaire was used to collect information on participants' ages, the number of pregnancies they had, their obstetric history, and whether they had received chemoprophylaxis while pregnant, and history of pre-term deliveries. Data on Blood pressure, haemoglobin levels and blood glucose were extracted from the maternal health record book. Additionally, data on the newborn was gathered and recorded, including the placenta's weight and the infant's birth weight.

2.2 Inclusion criteria

Preterm births, or births between 28 and 37 weeks, were regarded as premature. Low birth weight (LBW) babies were defined as singletons weighing less than 2,500 grams. Hundred (100) pregnant women in total were enrolled as study participants. Women were classified as primigravidae if they had just one pregnancy, paucigravidae if they had two or three, and multigravidae if they had more than three pregnancies. Out of the 100 women who were selected for the study, 50 of them had hypertensive related conditions, and so were taken as the study group. The other fifty (50) pregnant women did not have any pathological conditions like hypertension, pre-eclampsia, gestational diabetes, or any other condition during pregnancy and so were taken as the control group. Pregnant women with pre-eclampsia had sustained proteinuria of 300 mg/24 hours without a urinary tract infection and a sustained diastolic blood pressure of 90 mmHg or higher.

2.3 Exclusion criteria

Exclusion criteria included those with pre-existing hypertension, ischemic heart disease, chronic renal failure, diabetes mellitus, and those being treated with drugs that could affect lipid profiles. Gross proteinuria (measured by a urine heat test), pathological edema, and persistent hypertension (more than 140/90 mmHg) were utilized to diagnosis pre-eclampsia in patients.

Women who were pregnant but did not give their consent were not included in the study. Additionally, pregnant women older than 45 years and under 16 years were not included in the study.

2.4 Statistical analysis

Pre-eclampsia, severe pre-eclampsia, gestational hypertensives, full-term pregnancies, preterm births, BMIs below and above 30, and adverse birth outcomes were all categories used to categorize pregnant women. The analysis was performed using STATA 14 software.

2.5 Analytical Framework

A pregnant woman can have Pregnancy-Induced-Hypertension or not and so the response variable can take two values. Thus the probability of a pregnant woman to have Pregnancy-induced-Hypertension or not follows a binary or dichotomous response and so by Gujarati [26] the Logit model can be applied for such analysis.

An event's log-odds are a linear combination of one or more independent variables in the logit model, a statistical model that depicts the likelihood that the event will occur.

The following is the cumulative logistic distribution function:

$$P_i = \frac{1}{1+e^{z_i}} = \frac{e^z}{1+e^z} \quad (1)$$

Where

$$Z_i = \beta_0 + \beta_i X_i \quad (2)$$

Z can be between $-\infty$ to $+\infty$, and p_i can be between *0* and *1*. The likelihood that a pregnant woman will not experience pregnancy-induced hypertension is given by $1- p_i$, If p_i is the probability of a pregnant woman suffering from Pregnancy-induced-Hypertension. In this instance

$$1- p_i = \frac{1}{1+e^{z_i}} \quad (3)$$

The odd-ratio in favour of Pregnancy-Induced-Hypertension is given by

$$\frac{p_i}{1-p_i} = \frac{1+e^{z_i}}{1+e^{-z_i}} = e^{z_i} \quad (4)$$

If we take the natural log of equation (4) we get

$$ln\left(\frac{p_i}{1-p_i}\right) = Z_i = \beta_0 + \beta_i X_i + K \quad (5)$$

The relative effect of each independent variable on the likelihood that a pregnant woman suffers from Pregnancy-induced-Hypertension is given by the marginal effect

$$\frac{\partial(p_i)}{\partial(x_i)} = \beta_i[\bar{p}_i(1-\bar{p}_i)] \quad (6)$$

Where $\bar{P}_i$ is the mean of the dependent variable.

Odds ratios greater than 1 correspond to risk factors, those between 0 and 1 correspond to protective factors. Odds ratios of exactly 1 correspond to "no association." An odds ratio cannot be less than 0.

2.6 **Definitions of variables and their Measurements**

Table 1 is a summary of the definitions and measurements of the variables used in this study.

Table 1: Variables, their definitions, measurements and symbols

Variable Name	Definition and Measurement	Symbol
Age	Age of respondent in years	Age
Parity	Number of births given by respondent	Parity
Gravidity	Number of pregnancies by each respondent	Gravidity
Gestational Weight	Weight of mothers as a result of the pregnancy (kg)	GW
Glucose	Blood glucose level of respondent during pregnancy measured in milimoles per litre (mmol/L)	Glucose
Placenta Length	Placenta Length measured in centimeters	PL
Placenta Weight	Placenta weight measured in grams	PW

Umbilical Cord Lentgh	The Length of the Umbilical Cord measured in centimeters	UCL
Umbilical Cord Diameter	The diameter of the Umbilical Cord measured in centimeters	UCD
Total Cholesterol	The amount of cholesterol in the blood of the gestational mother measured in milimoles per litre (mmol/L)	Cholesterol
Body-Mass-Index	Mothers weight in kg divided by the square of the height in meters measured in Kg/m^2	BMI
High-Density-Cholesterol	The amount of High-Density Lipoprotein – Cholesterol in a gestational mother measured in milimoles per litre (mmol/L)	HDL
Low-Density-Cholesterol	The amount of Low-Density Lipoprotein – Cholesterol in a gestational mother measured in milimoles per litre (mmol/L)	LDL
White Blood Cells	The amount of white blood cells in a gestational mother or Volume of white blood cells measured in Millimeter cube	WBC
Red Blood Cells	The amount of Red blood cells in a gestational mother or Volume of red blood cells measured in Millimeter cube	RBC
Haemoglobin	Hemoglobin level of the mother measured in grams per deciliter	Hb

3. RESULTS AND DISCUSSION

The goal of this study is to identify risk and protective factors associated with hypertensive disorders amongst pregnant women in Ghana using the Bolgatanga Regional Hospital as a case study. The study's findings are presented in this section. Results of descriptive statistics that provided the mean, standard deviation, maximum and minimum values of the variables as well as results of inferential (empirical) statistics which also provided the odds ratios, standard errors, marginal effects and the p-values of the variables from the logistic regression are presented and discussed.

3.1 Descriptive Analysis

The summary of statistics of the variables used in this study are presented in Table 2. The sampled mothers' maternal ages (Age) ranged from 16 to 41 years old, according to the table. The standard deviation (SD) for maternal mothers' ages was found to be 6.55 years, or 27.84 years on average. The study's participants' parity was between 0 and 6 births, with a mean parity of 1.6 or 2 births and a standard deviation of 1.59.

The number of pregnancies (gravidity), however, was seen to range from 0 to 7, with a mean of 2.56 and a standard deviation of 1.67. Gestational weight (GW) was between 43.7 kg and 130 kg, with a mean weight of 70.44 kg and a standard deviation of 16.22 kg. When the blood sugar (glucose) levels of each study participant were measured, it was discovered that each one's range was between 7.9 mg/dL and 35 mg/dL, with a standard deviation of 9.42 mg/dL and average blood sugar level was 28.17 mg/dL.

An inelastic tape measure was used to measure the length of the placenta in women after delivery, and the results were documented. Placenta lengths for the research population ranged from 7.5 to 35 cm, with a mean length of 20.09 cm and standard deviation of 4.52 cm.

The average weight of the placenta was 613g, with a standard deviation of *170.77g.* The least weight of the placentas of the 50 women, was 300g and the maximum weight was found to be 1000g. As a result of the study, it was discovered that the mothers' umbilical cords ranged in length from 20cm to 85cm. On the average, the length of the umbilical cord was found to be 50.96 cm, with a standard deviation of 11.72cm. According to the study, mothers who were the subject of the investigation had

cords with an average diameter of 1.23cm and a range of 0.3cm to 2.2cm, with a standard deviation of 0.55cm.

The mothers' cholesterol levels were seen to be between 17.3mg/dL or 0.45mmol/L and 57mg/dl or 1.47mmol/L with a mean of 35.52mg/dl or 0.92mmol/L and a standard deviation (SD) of 9.01mg/dl or 0.23mmol/L. Similarly, the Body mass index (BMI) for the women were between 18.3kg/m^2 and 47.2kg/m^2. The average BMI was found to be 26.20kg/m^2, with a standard deviation of 5.84kg/m^2.

High-density cholesterol (HDL) had mean and standard deviation of 1.96mmol/L or 75.79mg/dL and 0.86mmol/L or 33.26mg/dL, respectively, according to the results. High-density cholesterol could only be measured to a maximum of 4mmol/L or 154.68mg/dL.

Low-density cholesterol (LDL) levels ranged from 0.3mmol/L or 11.60mg/dL to 16mmol/L or 618.72mg/dL at their highest and lowest values, respectively. LDL had a mean value of 6.435mmol/L or 248.84mg/dL, with a SD of 4.66mmol/L or 180.20mg/dL.

While the Red Blood Cell (RBC) count value ranged from 2.24 to 5.13, with a mean of 3.82 and a standard deviation of 5.60, the White Blood Cells (WBC) count had a mean of 13.59 and a standard deviation of 6.26, a maximum value of 30.95, and a minimum value of 4.78.

The study group's average hemoglobin (Hb) level was 10.38 with a standard deviation of 1.46; the lowest and highest levels were respectively 5 and 12.

Table 2: Descriptive statistics of variables.

Variable Name	Mean	Standard Deviation	Minimum	Maximum
Age	27.84	6.55	16	41
Parity	1.6	1.59	0	6
Gravidity	2.56	1.67	0	7
GW	70.44	16.22	43.7	130
Glucose	28.17	9.42	7.9	52.9
PL	20.09	4.52	7.5	35
PW	613	170.78	300	1000
UCL	50.96	11.72	24	85
UCD	1.23	0.55	0.3	2.2
Cholesterol	35.52	9.01	17.3	57
BMI	26.20	5.84	18.3	47.2
HDL	1.96	0.86	0	4
LDL	6.44	4.66	0.3	16.62
WBC	13.59	6.26	4.78	30.95
RBC	3.82	0.56	2.24	5.13
HB	10.38	1.46	5.2	12.8

Source: Authors' own estimation

3.2 Empirical Results

Results from the logistic regression model in Table 3 show that, there is a significant relationship between the dependent and independent variables used in this study and that the model fits the data well at 1% level of significance, indicating that the overall model is statistically significant. The model has an LR chi-squared value of 37.64 and a P-value of 0.0017, which is highly significant at 1% level. The model also has a log likelihood value of -14.8294 and a pseudo R^2 value of 0.5593.

Gestational weight (GW) has an odds ratio of 0.82 for the various independent factors, with a p-value of 0.079 indicating that there is some association between GW and pregnancy-induced hypertension, which is significant at the 10% level. An odds ratio of 0.82 means that the odds of a pregnant woman being hypertensive grow by 0.82 times larger for each additional weight gained during the pregnancy period.

Further, because the odds ratio is less than 1, GW is identified as a protective factor with a marginal effect of -0.0260. This finding supports the findings of Heude et al.[27], Kaiser & Kirby,. [28], Shao, et al.[29], and Viswanathan et al.[30].

The results were similar for placenta weight (PW), where the odds ratio was 0.994 with a p-value of 0.085, also significant at 10% level, and a marginal effect of -0.001, showing that if the placenta's weight increases by a kilogram, a pregnant woman's risk of pregnancy-induced hypertension decreases by 0.08%, a seemingly contradictory result. PW was identified as a protective factor. This supports the work of Barker et al. [37]

Body mass index (BMI) was found to be statistically significant (p-value of 0.025) at the 5% level of significance; an odds ratio of 2.208, which is more than 1, indicates a substantial relationship between BMI and pregnancy-induced hypertension. Additionally, it has a 0.101 marginal effect. Accordingly, a pregnant woman's risk of developing pregnancy-induced hypertension rises by around 10% for every kilogram she accumulates. The findings of Cnattingius et al. [31] and Bhattacharya et al.[32], which demonstrated that obesity and, by extension, a higher BMI, are bigger risk factors for preeclampsia, are supported by this finding. The study identified BMI as a risk factor (odds ratio greater than 1).

The findings showed that LDL was highly statistically significant at 5% with a p-value of 0.027, suggesting a relationship between LDL and pregnancy-induced hypertension. The odds ratio of 0.645 and marginal value of -0.056. This means that the probability of a pregnant woman becoming hypertensive during her pregnancy increases by 64.5% for every unit increase of LDL. These findings are consistent with those made by Uzun, et al.[33].

The odds ratio (0.79) of the White Blood Cells is significant (p-value 0.01) at the 5% level with a marginal effect of -0.042. This shows that there is a relationship between WBC and gestational hypertension. Research by Hernandez et al. [34] provided conclusive evidence that preeclampsia is also influenced by changes in the morphology of leukocytes, or white blood cells. The Red Blood Cells (RBC) and Haemoglobin, (Hb) on the other hand, were found to be statistically insignificant and to have no relation to pregnancy-induced hypertension.

Table 3: Logit Model estimates of the Probability of Prenancy-Induced-Hypertension.

Variable Name	Odds Ratio	Standard Error	Marginal	P-value
Age	0.943	0.098	-0.007	0.576
Parity	1.745	2.172	0.071	0.655
Gravidity	0.952	1.057	-0.006	0.965
GW	0.815	0.095	-0.026	0.079*
Glucose	0.963	0.063	-0.005	0.569
PL	0.943	0.096	-0.007	0.565
PW	0.994	0.004	-0.001	0.085*
UCL	1.096	0.066	0.011	0.126
UCD	0.696	0.673	-0.046	0.708
Cholesterol	1.061	0.079	0.008	0.423
BMI	2.208	0.781	0.101	0.025**
HDL	0.608	0.463	-0.063	0.514
LDL	0.645	0.128	-0.056	0.027**
WBC	0.719	0.092	-0.042	0.01***
RBC	0.110	0.149	-0.282	0.105
Hb	0.700	0.318	-0.046	0.432

** = p < 0.10, **= p < 0.05, *** = p < 0.01*

Source: *Authors' own estimation*

3.3 DISCUSSION

Pregnancy-related hypertension diseases continue to be a significant public health problem worldwide, particularly in developing countries like Ghana. This condition's origin is uncertain. The risk factors for hypertensive diseases in both industrialized and developing nations have been the subject of several research. The findings of these various studies demonstrate that the contributing factors differ between nations and between institutions. This study, therefore, sought to identify the risk and protective factors associated with hypertensive disorders among pregnant women in the Bolgatanga Regional hospital.

In this study, BMI was identified as a risk factor (OR=2.21). Also from the descriptive statistics, the pregnant women had an average BMI value of 25.72. This value is greater than the normal BMI value which should lie between 18.5 and 24.9. This means that on the average the women were overweight and hence at a significantly increased risk of developing hypertensive disorders during the period of their pregnancy. This finding corroborates with other studies in which BMI was reported as an independent risk factor for hypertensive disorders, such as Cnattingius et al. [31] and Bhattacharya et al. [32], which demonstrated that obesity and, by extension, a higher BMI, are bigger risk factors for preeclampsia. This finding is also in tandem with Chuka, et al [35] who found that the prevalence of hypertension was higher in those who were overweight and obese compared to those who were of a healthy weight, in their investigation to ascertain the relationship between BMI and hypertension in individuals living in the Arab Minch.
However the study identified GW as a protective factor (OR<1). This findings corroborates with that of [27, 28, 29 30] but contradicts the work of [36] where they found GW to be a risk factor.
Placenta weight was also identified as a protective factor (OR <1). This results supports the work of Barker et al [37].
Low-density lipoprotein and White Blood Cells had similar results. They were both found to be protective as they both had their odds ratios being less than one. The results are in line with the findings of Uzun, et al [33] and Hernandez et al. [34]. However, LDL had a mean value of 6.44mmol/L which is rather quite high compared to the normal LDL value of less than 2.586mmol/L or 100mg/dL
RBC and Haemoglobin were surprisingly found not to be statistically significant.

4. CONCLUSION

The aim of this study was to identify some risk and protective factors associated with pregnancy-related hypertension in Ghana, using the Bolgatanga Regional Hospital of the Upper East Region of Ghana as a case study. 50 pregnant women who had hypertensive-related conditions were used for the study and the logistic regression model of STATA 14 was used to analyze the data. Results from the study indicates that pregnant women who gain weight or become obese during their gestational period are more likely to develop or experience hypertensive disorders during their pregnancy period.
The study identified body mass index (BMI) as a risk factor (because it's odd ratio was more than one) whilst gestational weight, placenta weight, low-density lipoprotein cholesterol, and white blood cell count were identified as protective factors (because their odds ratios were less than one).

5. LIMITATION OF THE STUDY

This study had a few drawbacks. The study was conducted in a single hospital, thus its findings cannot be applied generally. The pregnant ladies and their relatives were unwilling to fully and correctly provide information because it is considered intimate and sensitive to discuss sexually related things. This could skew the results of the study and add some bias-related elements. Additionally, data on excessive trans-fat dietary intake and a family history of hypertension were not gathered, both of which have a major impact on the development of hypertensive diseases in pregnant women.

Based on the results of this study, we advise conducting a broader investigation to learn more about the incidence and relative prevalence of hypertensive diseases during pregnancy in Ghana and Sub-Saharan Africa as a whole.

6. RECOMMENDATION

Considering the study's findings, it would be recommended that some extended prospective studies be done to confirm or otherwise of this findings as this study was a one case study and so the finding could not be generalized for the region or nation. The confirmation or otherwise of our findings would help develop strategies or policies that would help prevent the prevalence of hypertensive disorders among pregnant women in the region and the nation at large. This policies of prevention should include health campaigns and education.

To raise awareness of the risks of hypertensive disorders among pregnant women, it is advised that women be educated on the risk factors of this condition even before they become pregnant, with particular attention to keeping healthy weight. The Regional Health Management Team's medical and paramedical professionals might coordinate campaigns and health education on pregnancy-induced hypertension in the region and the country at large.

ETHICAL APPROVAL

The Navrongo Health Research Institute's Institutional Review Board gave the study their seal of approval.

CONSENT

All expecting mothers who were being admitted to the maternity ward of the Upper East Regional Hospital, Bolgatanga, and ready to participate in the study gave their consent.

DATA AVAILABILITY

The data for this study are not available due to confidentiality of the participants' privacy

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