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## Hypertensive Disorders (HDP) In Pregnancy at the Bono Regional Hospital in Ghana

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**Abstract:** Hypertensive Disorders of Pregnancy (HDP) is one of the leading causes of maternal, neonatal, and infant mortality. Several studies have suggested that the occurrence of HDP may be dependent on environmental factors. Although, several countries have documented the prevalence of HDP with its mode of delivery and birth outcomes, and some parts of Ghana have data on these, little is known about the prevalence of HDP in the Bono Region. This study would therefore be conducted to determine the prevalence, the type of delivery, and birth outcomes of women with HDP in the Bono Regional Hospital. This was a retrospective cohort study. Guided by a data extraction sheet, a review of all pregnancies that were reported to the hospital between 1st January 2016 and 31st December 2019 was done. For each month, the percentage of mothers who presented with any of the HDPs was calculated. Maternal age, parity, birth weight, mode of delivery, birth outcomes, and occurrence of Gestational Hypertension (GH), preeclampsia, and Eclampsia were variables evaluated and analyzed using Statistical Package for Social Sciences (SPSS) for Windows, version 26.0. It is expected that the study would provide the data required to put in place interventions to improve birth outcomes among people with HDP.

**Keywords:** Hypertensive Disorders, Pregnancy, Bono Regional Hospital, Ghana, Prevalence, Risk Factors, Maternal Health, Preeclampsia, Gestational Hypertension, Chronic Hypertension, Antenatal Care, Complications, Management, Healthcare Practices.

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### 1. INTRODUCTION

Hypertensive Disorders of Pregnancy (HDP) is one of the major complications of pregnancy, which poses a major threat to the life of the mother and the baby. It is a multi-system disorder

whose clinical manifestation is known to be progressive with potentially fatal sequelae and this accounts for why the mainstay of management is to expedite delivery. It is one of the top five causes of maternal death with most of these deaths occurring in low-income countries. Efforts are being made to help better understand the etiology and the pathophysiology of the disease to get a grip on a definitive cure. Hypertensive disorders of pregnancy are extremely common worldwide and have been reported to be responsible for 12% of maternal mortality during pregnancy and the puerperium (Bellamy et al., 2007). Increased blood pressure is common in all cases of Hypertensive Disorders of Pregnancy (HDP).

Hypertensive disorders of pregnancy (HDP) complicate 5% to 10% of pregnancies and are increasing with the rising prevalence of cardiometabolic diseases in younger women (Hutcheon et al., 2011). The reported incidence of preeclampsia varies between 3-10% (Mittendorf et al., 1996). In Tehran, an incidence of 3% for preeclampsia has been reported (Pyri, S.;Kiani, A.; and Faghizadeh, 2001) and in Sri Lanka, hypertensive disorders of pregnancy have been reported to occur in 4.9% of pregnant women delivering in a tertiary care hospital (Jayawardana, 1995). In a Ghanaian study, conducted in Accra, a prevalence of 7.9% for preeclampsia was reported (ADU-BONSAFFOH et al., 2017) and one was done in Kumasi concluded an incidence of 9.03% for Preeclampsia (Owiredu et al., 2010).

Varying risk factors such as maternal age, Body Mass Index (BMI), parity, family history of hypertension, contraceptive use, oxidative stress, and metabolic syndrome among women presenting with HDP visiting the Komfo Anokye Teaching Hospital (KATH) have been established (Owiredu W.K.B.A., Ahenkorah L., Turpin C.A., 2009). In this study, some level of attention is being paid to the physical environment which has also been implicated in the etiology of hypertensive disorders in pregnancy. Many studies all over different parts of the world have tried to establish or confirm the relationship that exists between the physical environment (meteorological parameters) and the occurrence of HDP but only one study has been conducted in Ghana and it was conducted in Komfo Anokye Teaching Hospital (KATH), Kumasi. A great deal of work was done and confirmed a possible relationship between seasons and the occurrence of HDP (Owiredu et al., 2010) but data on Eclampsia was excluded. The climate changes that occur in Kumasi, Ghana which is located close to the southern part of Ghana vary from climate changes experienced in the northern part of the Mid north parts of the country. However, this research work pays attention to the prevalence of hypertensive disorders in pregnancy at the Bono Regional Hospital in Ghana.

## **2. METHOD**

### **Study Site**

The study was conducted in the Bono regional hospital located in Sunyani. The Bono regional hospital was purposely selected due to its description as the regional referral hospital for all health facilities within the region. It is the largest, main referral center for the Bono Region as well as some of its neighboring regions. The hospital is divided into departments. These include obstetrics and gynecology, medicine, surgery, pediatrics, laboratory, and pharmacy. Each department has a specialist who heads the department and ensures optimum care is given to patients. The obstetrics and Gynaecology department has a consultant who helps in the running of the department. The department has 4 specialists who are well-trained and know the accurate management of cases. Because of the presence of a consultant and the specialist, the department is one of the few hospitals where residents in obstetrics and gynecology at KATH offer their district rotations. The hospital is having a working population of over one thousand including both medical and non-medical staff.

## Study Design

A Retrospective cohort study was used in this research. A retrospective analysis of hospital-based data was used because the purpose of the study is to determine the prevalence of HDP and its maternal and perinatal outcomes in the Bono Regional Hospital and it is the most appropriate design to use.

## Study Population

The study population constituted women who were admitted to the Obstetrics and Gynaecology department of Bono Regional Hospital in 2016-2019. They were chosen because their data were the ones which were adequate/complete and could help come out with a better finding in the study.

## Sampling Technique

All pregnant women who delivered in the health facility between 1<sup>st</sup> January 2016 to 31<sup>st</sup> December 2019 were included in the study. Women who met the globally acknowledged consensus classification by the International Society for the Study of Hypertension in Pregnancy (ISSHP) were added to the study. Gestational hypertension was defined as blood pressure  $\geq$  140/90 mmHg arising de novo after 20 weeks gestation in the absence of proteinuria and without biochemical or hematological abnormalities; preeclampsia was defined as blood pressure  $\geq$  140/90 mm Hg arising de novo after 20 weeks' gestation accompanied by proteinuria and/or evidence of biochemical or hematological abnormalities (maternal acute Kidney injury, liver dysfunction, neurological features, hemolysis or thrombocytopenia, or fetal growth restriction).

## Sample Size

The study used Cochran to calculate the required sample size for the study

$$n = \frac{z^2 P(1-p)}{e^2}$$

n=required sample size

z=confidence interval of 95%=1.96

p=assumed proportion from similar studies is 24% = 0.24

q= probability of the event not occurring in the event, in this case, is 1-0.24

e= sampling error of 5% = 0.05

$$n = \frac{1.96^2 \times 0.24(1-0.24)}{0.05^2}$$

$$= \frac{0.701}{0.0025}$$

$$= 280.28$$

$$= 280$$

$$= 280$$

$$= 280$$

Adding a non-response rate of 10/100x280=28.0

$n=280.28+28.0=308.28$

Therefore, sample size =310

### **Inclusion And Exclusion Criteria**

Women who met the globally acknowledged consensus classification and were admitted and diagnosed with Gestational Hypertension, Preeclampsia, and eclampsia were included in the study. Subjects presenting with chronic hypertension and chronic hypertension with superimposed preeclampsia were excluded from this study. Also, subjects who had milder forms of HDP (Gestational Hypertension, Mild Preeclampsia) who were not admitted were excluded because the data available was incomplete and couldn't be used

### **Data Collection Tool and Technique**

Secondary data from Admission and Discharge records of women who were on admission at the Obstetrics and Gynaecology department in the Bono Regional Hospital from 2016 to 2019 was used for gathering the data. Secondary data from Theatre Records and Labour Ward was also used for data collection. The diagnosis of gestational hypertension and preeclampsia was made based on clinical and laboratory findings by Obstetrics and Gynaecology specialists using the definitions by the International Society for the Study of Hypertension in Pregnancy (ISSHP). The number of cases admitted that met the definition by the ISSHP per month will be tabulated.

### **Data Analysis**

The data were coded, entered, and analyzed using statistical product and service solutions (SPSS)

### **Ethical and institutional approval**

The study protocols were submitted to the Ethical review committee of the Ghana Health Service Research and Development Division, Accra with a GHS-ERC number 020/02/21

## **3. RESULTS**

**The prevalence of HDP among women who attends Bono Regional Hospital.**

From the data collected, in 2016, four (4) of the women who delivered had gestational hypertension, 52 had preeclampsia, and 18 had eclampsia. In 2017, 1 had gestational hypertension, 56 had preeclampsia and 10 had eclampsia. In 2018, 10 had gestational hypertension, 72 had preeclampsia and 9 had eclampsia. In 2019, 4 had gestational hypertension, 64 had preeclampsia and 6 had eclampsia.

In January for all four years, none had gestational hypertension in 2016 and 2019. 1(one) had gestational hypertension in both 2017 and 2018 representing (12.5%) and (25%) of the respective years. For preeclampsia, the data indicates 2(50%), 6(75%), 3(75%), and 4 (80%) respectively for the four respective years 2016 to 2019.

In February, none of the years recorded a case of gestational hypertension. 6 (66.7%), 5 (100%), 1 (100%), and 3(100%) were cases of preeclampsia recorded in the respective years respectively. For eclampsia, only 2016 had cases recorded 3(33.3%).

For March too, there was no case of gestational hypertension in all four years, for preeclampsia, the cases recorded were 3 (75%), 7(87.5%), 2(50%), and 5 (100%) respectively between 2016 and 2019. Cases for eclampsia were 1(25%), 1(12.5%), and 2 (50%) respectively between 2016 and 2018 with none in March 2019.

From April, no case was recorded in all four years concerning gestational hypertension. For preeclampsia, 3(60%), 4(80%), 5 (100%), and 4 (100%) respectively between 2016 and 2019. 2 (40%), and 1 (20%) were cases recorded for 2016 and 2017 for eclampsia and no cases recorded for 2018 and 2019.

In May, no case of gestational hypertension was recorded in 2016 and 2017 whilst 2018 and 2019 recorded 1(17%) and 1(10%) respectively. For preeclampsia, 7 (87.5%), 4 (80%), 5 (83%), and 7 (70%) were cases recorded respectively between 2016 and 2019. Eclampsia for the four years respectively, the cases recorded as 1(12.5%), 1 (20%) 0(0%), and 2 (20%).

The month of June had cases of gestational hypertension for 2016 and 2018 as 1(12.5%) and 1(16%) respectively with no cases in 2017 and 2019. 5(62.5%), 5(83%), 5(83%) and 8 (88.9%) were cases recorded respectively for all four years. 3 (25.5%), 1(17%), 0%, and 1(11.1%) were cases of eclampsia recorded for the four years.

For July, gestational hypertension recorded 1(20%) case in 2016, none in 2017, 5(45.5%) in 2018 and none in 2019. Concerning preeclampsia, 4 cases (80%), 2 cases (66.7%), 5 cases (45.5%), and 13 (100%) were cases recorded between 2016 to 2019 respectively. For eclampsia, no case was recorded in 2016 and 2019. In 2017 1 case constituted 33.3% of HPD cases recorded for the period likewise in 2018 1 case represented 9% of HPD cases recorded for the period.

None of the years recorded a case in August except for 2018 which was 1 case representing 11.1% of HPD cases recorded in the period. Preeclampsia had 6 cases representing 85.7% of HPD cases in that particular period, 4 cases representing 80% of HPD cases for the period, 8 cases representing 88.9% of HPD cases for that period and 3 cases representing 100% of cases recorded in that period being the only cases recorded all from 2016 to 2019 respectively.

September had 2 (40%), 0 (0%), 1 (11.1%) and 2(40%) cases being gestational hypertension from 2016 to 2019 respectively. For preeclampsia 2(40%), 5(100%), 8 (88.9%) and 1 (20%) were cases recorded in those periods from 2016 to 2019 respectively. Eclampsia on the other side had no cases recorded in 2017 and 2018. 1 (20%) and 2 (40%) cases of Eclampsia were recorded in 2016 and 2019 respectively.

In October none of the years recorded a case of gestational hypertension. Preeclampsia recorded 9(81.1%), 7(87.5%), 10(77%), and 4 (100%) cases of HPD in the respective years 2016 to 2019. Eclampsia had 2(18.9%), 1(12.5%), and 3 (23%) of HPD cases recorded from 2016 to 2018 respectively. 2019 had no case of eclampsia recorded.

In November, only 2019 recorded a case of gestational hypertension 10% of HPD cases recorded for that month in that year. The rest of the years recorded no cases. 4 (80%), 4 (100%), 8 (88.9%) and 9(90%) were cases of preeclampsia recorded from 2016 to 2019 respectively. For eclampsia 2016 and 2018 recorded a case each but they represented 20% and 11.1% of HPD cases recorded in those years respectively. No case was recorded in 2017 and 2019.

No case of gestational hypertension was recorded in December in all four years. Preeclampsia had 1(50%), 3(100%), 12(85.7%), and 3(100%) cases of HPD recorded from 2016 to 2019 in December. For eclampsia 2016 had 1(50%) and 2018 also had 2(14.3%) of HPD cases recorded in December. 2017 and 2019 had no cases.

Table 1: Hypertensive Disorders (Gestational hypertension (G.H), Preeclampsia (P.E), and Eclampsia (E)) and cases recorded for each month between 2016 to 2019.

Months	2016			2017			2018			2019		
	G.H	P.E	E	G.H	P.E	E	G.H	P.E	E	G.H	P.E	E
	%	%	%	%	%	%	%	%	%	%	%	%
J	-	2(50)	2(50)	1(12.5)	6(75)	1(12.5)	1(25)	3(75)	-	-	4(80)	1(20)
F	-	6(66.7)	3(33.3)	-	5(100)	-	-	1(100)	-	-	3(100)	-
M	-	3(75)	1(25)	-	7(87.5)	1(12.5)	-	2(50)	2(50)	-	5(100)	-
A	-	3(60)	2(40)	-	4(80)	1(20)	-	5(100)	-	-	4(100)	-
M	-	7(87.5)	1(12.5)	-	4(80)	1(20)	1(16)	5(83)	-	1(10)	7(70)	2(20)
J	1(12.5)	5(62.5)	3(25.5)	-	5(83)	1(17)	1(16)	5(83)	-	-	8(88.9)	1(11.1)
J	1(20)	4(80)	-	-	2(66.6)	1(33.3)	5(45.5)	5(45.5)	1(9)	-	13(100)	-
A	-	6(85.7)	1(14.3)	-	4(80)	1(20)	1(11.1)	8(88.9)	-	-	3(100)	-
S	2(40)	2(40)	1(20)	-	5(100)	-	1(11.1)	8(88.9)	-	2(40)	1(20)	2(40)
O	-	9(81.1)	2(18.9)	-	7(87.5)	1(12.5)	-	10(77)	3(23)	-	4(100)	-
N	-	4(80)	1(20)	-	4(100)	-	-	8(88.9)	1(11.1)	1(10)	9(90)	-
D	-	1(50)	1(50)	-	3(100)	-	-	12(85.7)	2(14.3)	-	3(100)	-
<b>Total</b>	<b>4</b>	<b>52</b>	<b>18</b>	<b>1</b>	<b>56</b>	<b>10</b>	<b>10</b>	<b>72</b>	<b>9</b>	<b>4</b>	<b>64</b>	<b>6</b>

**The prevalence of HDP among women who attends Bono Regional Hospital (2016-2019).**

Table 4 below, reveals that the total ANC attendance for January is 341. Out of this, 21 representing 21(6.16%) were with HPD. 2(9.5%) had gestational hypertension, 15 (71.4%) had preeclampsia and 4 (19.1%) had eclampsia. The total number of ANC attendance for February was 325 and the total number of HPD cases recorded was 18 (5.5%). None had gestational hypertension while 15 (83.3%) had preeclampsia and 3(7.7%) had eclampsia. March had 336 ANC attendance and 21(6.25%) HPD vases recorded. Of the 21 cases, there was no case of gestational hypertension but 17 (81%) cases of preeclampsia and 4(19%) cases of eclampsia. April had 321 ANC attendance with 19 (5.9%) cases of HPD. Of these, no cases of gestational hypertension, 16(84.2%) cases of preeclampsia, and 3 (18.8%) cases of eclampsia. ANC attendance for May in total was 342, of which 30 (8.8%) had cases of HPD. 3(10%), 23 (76%) and 4 (13.3%) were cases of gestational hypertension, preeclampsia, and eclampsia recorded respectively. For June, total ANC attendance from 2016 to 2019 was 337 of which 31(9.2%) had cases of HPD. 3(9.7%), 23(74.2%) and 5 (16.1%) were the cases recorded for gestational hypertension, preeclampsia, and eclampsia respectively. Total ANC attendance for July for the four years was 311 with 34 (10.9%) with HPD. 6 (17.6%), 24(70.6%), and 4 (11.8%) were cases of gestational hypertension, preeclampsia, and eclampsia recorded respectively. For August, 34 HPD cases were 7.9% of the total 305 cases recorded in total from 2016 to 2019. Of these, 1(4.7%), 21(87.5%), and 2 (8.33%) were respectively cases of gestational hypertension, preeclampsia, and eclampsia recorded for the four years in total.

September recorded 321 ANC attendance with 24 (7.5%) HPD cases recorded. Of the 24, 5(20.8%), 16(60.6%), and 3 (12.5%) were cases of gestational hypertension, preeclampsia, and eclampsia recorded. October had 374 ANC attendance with 36(9.63%) HPD cases. 30 (83.3%) and 6 (16.7%) were cases of preeclampsia and eclampsia recorded respectively in the period. No case of gestational hypertension was recorded. November on the other hand, had 360 ANC attendance with 28 (77.78%) cases of HPD recorded. 1(3.6%), 25(89.3%) and 2(7.1%) were cases of gestational hypertension, preeclampsia, and eclampsia recorded in all four years put together.

In December, 344 ANC attendance were recorded with 24(7%) cases of HPD. 2(8.3%), 19(79.2%), and 3(12.5%) were cases of gestational hypertension, preeclampsia, and eclampsia recorded in the period. HPD occurrence in women is not significantly related to any month of the year ( $X^2=56.73$ ,  $p=0.74$ ).

**Table 4: The prevalence of HDP among women who attends Bono Regional Hospital (2016-2019).**

HPD	Age			Total	$x^2=64.707$ , $P=0.003$
	< 20	20-35	>35		
Gestational Hypertension	2(7.7%)	15(6.8%)	8(12.3%)	25	
Pre-Eclampsia	12(46.2%)	176(80.4%)	42(64.6%)	230	
Eclampsia	12(46.2%)	28(12.8%)	15(23.1%)	55	

Total	26(8.4)	219(70.6)	65(21)	310
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**Table 5 Distribution of women with hypertensive disorders with age (2016-2019)**

Months	2016-2019					Prevalence of HPD	X <sup>2</sup> =56.73, p=0.74
	Atn. %	G.H%	P.E%	E%			
Jan	341	2(9.5)	15(71.4)	4(19.1)	21 (6.16%)		
Feb	325	0	15(83.3)	3(17.7)	18(5.54%)		
March	336	0	17(81)	4(19)	21(6.25%)		
April	321	0	16(84.2)	3(18.8)	19(5.9%)		
May	342	3(10)	23(76.7)	4(13.3)	30(8.8%)		
June	337	3(9.7)	23(74.2)	5(16.1)	31(9.2%)		
July	311	6(17.6)	24(70.6)	4(11.8)	34(10.9%)		
August	305	1(4.17)	21(87.5)	2(8.33)	24(7.9%)		
September	321	5(20.8)	16(60.6)	3(12.5)	24(7.5%)		
October	374	0	30(83.3)	6(16.7)	36(9.63%)		
November	360	1(3.6)	25(89.3)	2(7.1)	28(7.78%)		
December	344	2(8.3)	19(79.2)	3(12.5)	24(7%)		
<b>TOTAL</b>	<b>4017</b>	<b>23(0.57%)</b>	<b>244(6.1%)</b>	<b>43(1.1%)</b>	<b>310(7.7%)</b>		

From Table 5 below, the 26 women who had HPD were below 20 years. 2(7.7%) had gestational hypertension 12(46.2%) had preeclampsia whiles 12(46.2%) of them had eclampsia. Of the 219 women between 20 and 35 years, 15(6.8%) of the women had gestational hypertension and 176 (80.4%) had preeclampsia whiles 28 (12.8%) had eclampsia. Finally of the 65 who were aged above 35 years 8(12.3%), had gestational hypertension, 42(64.6%) had preeclampsia and 15 (23.1%) had eclampsia. Age can be said to be significantly related to HPD ( $\chi^2=64.707$ ,  $p=0.003$ ).

The data in Table 5 presents the relationship between age and hypertensive pregnancy disorders (HPD) in a group of women. The table is divided into three age groups: women below 20 years, women between 20 and 35 years, and women above 35 years. For each age group, the number and percentage of women with different types of HPD (gestational hypertension, preeclampsia, and eclampsia) are provided.

Firstly, let's focus on women below 20 years:

Out of the 26 women in this age group, the distribution of HPD is as follows:

- 2 women (7.7%) had gestational hypertension.
- 12 women (46.2%) had preeclampsia.
- 12 women (46.2%) had eclampsia.

Next, let's consider women between 20 and 35 years:

Out of the 219 women in this age group, the distribution of HPD is as follows:

- 15 women (6.8%) had gestational hypertension.
- 176 women (80.4%) had preeclampsia.
- 28 women (12.8%) had eclampsia.

Finally, let's look at women above 35 years:

Out of the 65 women in this age group, the distribution of HPD is as follows:

- 8 women (12.3%) had gestational hypertension.
- 42 women (64.6%) had preeclampsia.
- 15 women (23.1%) had eclampsia.

There is a significant relationship between age and HPD based on a statistical test. The Chi-square test was used to assess this relationship. The result of the Chi-square test is reported as follows:

- Chi-square value ( $\chi^2$ ) = 64.707
- p-value (probability value) = 0.003

The small p-value (0.003) indicates that the relationship between age and HPD is unlikely to have occurred by chance alone. In other words, age does seem to have a significant association with the occurrence of hypertensive pregnancy disorders in this sample of women.

The data in Table 5 suggests that the prevalence of different types of HPD varies across different age groups, and there is a statistically significant relationship between age and HPD in this particular population.

Table 6: Mode of delivery amongst women with HDP at the Bono Regional Hospital (2016-2019)

HPD	Mode of delivery		
	SVD	Cesarean	Total

$\chi^2 = 64.44$  ,  $p = 0.003$

Gestational Hypertension	10(18%)	15 (5.9%)	25
Pre Eclampsia	33(60%)	195 (76.5%)	228
Eclampsia	12(22%)	28 (10.9%)	40
<b>Total</b>	<b>55(17.7)</b>	<b>255 (82.3)</b>	<b>310</b>

From Table 6 above, of the 55 women who had delivered by SVD 10 (18%) had gestational hypertension, 33(60%) had preeclampsia and 12 (22%) had eclampsia. Also, for the 255 women who delivered employing Caesarean session, 15(5.9%) had gestational hypertension, the Majority being 195 (76.5%) had preeclampsia and 28(10.9%) had eclampsia. HPD from the data gathered is significantly related to the mode of delivery ( $\chi^2 = 64.44$ ,  $p = 0.003$ ).

Based on the data presented in Table 6, which includes information on the mode of delivery and hypertensive disorders of pregnancy (HPD) among women, we can draw several conclusions.

The table shows that out of the 55 women who had a spontaneous vaginal delivery (SVD), the distribution of hypertensive disorders was as follows:

- 10 women (18%) had gestational hypertension,
- 33 women (60%) had preeclampsia, and
- 12 women (22%) had eclampsia.

On the other hand, among the 255 women who delivered through Caesarean section:

- 15 women (5.9%) had gestational hypertension,
- 195 women (76.5%) had preeclampsia, and
- 28 women (10.9%) had eclampsia.

From these numbers, it is evident that preeclampsia was the most common hypertensive disorder among both groups, irrespective of the mode of delivery. However, it appears that the incidence of gestational hypertension was relatively higher among women who had a spontaneous vaginal delivery (18%) compared to those who underwent Caesarean section (5.9%). Conversely, eclampsia seems to have a similar distribution between the two delivery groups.

The statistical analysis indicates a significant relationship between hypertensive disorders of pregnancy and the mode of delivery ( $\chi^2 = 64.44$ ,  $p = 0.003$ ). This suggests that the mode of delivery may have an impact on the development of hypertensive disorders during pregnancy.

Table 7: The Birth Outcomes of Women with HDP.

HPD	Birth outcomes			$X^2 = 64.69, p = 0.002$
	NICU	Doing Well	Still Birth	
Gestational Hypertension	2(1.4%)	21(12.7%)	-	
Pre-Eclampsia	127(90.7%)	114(86.7%)	3(75%)	
Eclampsia	11(7.9%)	31(18.7%)	1(25%)	
<b>Total</b>	<b>140(45.2%)</b>	<b>166(53.5%)</b>	<b>4(1.3%)</b>	

Out of 140 women whose babies were in NICU 2(1.4%) had gestational hypertension, 127 (90.7%) had preeclampsia, and 11(7.9%) had eclampsia. Of the 166 women whose babies were doing well 21(12.7%) had gestational hypertension while 114 (86.7%) had preeclampsia. The remaining 11(7.9%) had eclampsia. Finally, of the 4 (four) who experienced stillbirth, none had gestational hypertension, 3 (75) had preeclampsia and 1 had eclampsia.

**Let's summarize the information given:**

For the 140 women whose babies were in NICU:

- 2 (1.4%) had gestational hypertension.
- 127 (90.7%) had preeclampsia.
- 11 (7.9%) had eclampsia.

For the 166 women whose babies were doing well:

- 21 (12.7%) had gestational hypertension.
- 114 (86.7%) had preeclampsia.
- The remaining 11 (7.9%) had eclampsia.

For the 4 women who experienced stillbirth:

- None had gestational hypertension.
- 3 (75%) had preeclampsia.
- 1 had eclampsia.

Now, let's calculate the total number of women in each group based on the given data:

1. Total number of women with gestational hypertension: In NICU group: 2 In doing well group: 21 In stillbirth group: 0 Total:  $2 + 21 + 0 = 23$
2. Total number of women with preeclampsia: In NICU group: 127 In doing well group: 114 In stillbirth group: 3 Total:  $127 + 114 + 3 = 244$

- Total number of women with eclampsia: In NICU group: 11 In doing well group: 11 In stillbirth group: 1 Total: 11 + 11 + 1 = 23

Now, let's calculate the percentage of women in each group:

- Percentage of women with gestational hypertension:  $(23 / (140 + 166 + 4)) * 100 \approx 6.36\%$
- Percentage of women with preeclampsia:  $(244 / (140 + 166 + 4)) * 100 \approx 67.91\%$
- Percentage of women with eclampsia:  $(23 / (140 + 166 + 4)) * 100 \approx 6.36\%$

**Note:** The percentages are rounded to two decimal places for clarity.

**Table 8 Maternal Deaths Associated with HDP**

maternal death occurrence	Causes of death				Total Deaths	$\chi^2 = 43.14$ , $p = 0.004$
	Gestational Hypertension	Preeclampsia	Eclampsia	others		
2016	-	3(33.3%)	5(55.6%)	1(11.1%)	9	
2017	-	2(40%)	2(40%)	1(20%)	5	
2018	-	1(25%)	3(75%)	-	4	
2019	-	-	-	1(100%)	1	
<b>Total</b>	-	<b>6(31.6%)</b>	<b>10(52.6%)</b>	<b>3(15.9%)</b>	<b>19</b>	

From the above data, none of the women who died had gestational hypertension. For preeclampsia 3(33.3), 2(40), and 1(2) died from 2016 to 2018 respectively. For eclampsia 5(55.6), 2(40) and 3(75) were maternal deaths caused by eclampsia from 2016 to 2018 respectively, other factors caused 1 death each year except 2018. No maternal death was recorded in 2019 concerning any of the HPDs. There is a significant relation between the years and maternal deaths ( $\chi^2 = 43.14$ ,  $p = 0.004$ ) as there is a steady reduction of deaths caused by HPD from 9 to 5 to 4 and to none from 2016 to 2019 respectively.

The data shows a significant reduction in maternal deaths caused by hypertensive pregnancy disorders (HPDs) over the years 2016 to 2019. This suggests that efforts to address and manage HPDs may have been successful in improving maternal health outcomes. However, further research and data would be needed to identify the specific factors contributing to this positive trend and to continue efforts to reduce maternal mortality related to HPDs in the future.

#### 4. DISCUSSION

##### **The Prevalence of HDP among Women who Attends Bono Regional Hospital.**

From the data gathered, the prevalence rate of hypertensive disorders among pregnant women in the Bono region is 7.7%. This rate compared to many is relatively low hence encouraging. For gestational hypertension, the prevalence rate is relatively low being 0.57%, with preeclampsia

being 6.1% and Eclampsia being 1.1%. The prevalence rate of preeclampsia confirms the findings of Ying et al 2018 where they arrived at 5 to 7% but that of gestational hypertension is far below the findings of Ying et al 2018 who had 6 to 7%. Unlike the report of Abalos et al 2014 where the prevalence rate of eclampsia was 0.3%, this study finds the prevalence of eclampsia to be 1.1%, a little higher than the findings of Abalos. With the prevalence rate of HPD in the United States ranging between 6% to 8%, according to Naderi et al 2017, a prevalence rate of 7.7% in the Bono region is in tune with the findings even though it is above that of the United Kingdom which ranges between 5.4% to 7% (Naderi et al., 2017). It is however a better rate than the prevalence of 8.2% in Australia (Umesawa & Kobashi, 2017). In Africa, the prevalence of HDP is 10% according to Noubiap et al after a systematic review and meta-analysis (Noubiap et al., 2019), this puts the 7.7% prevalence rate in the Bono region at a better rate even though more could be than like in the United Kingdom. On the African continent, Ethiopia had a prevalence rate of 6.07% (Berhe et al., 2018) which is below that of this study. It therefore indicates far lower prevalence levels are attainable on the African continent as Nigeria can attain as low as 5% (Hayman, 2004). On the whole, the prevalence rate of 7.7% in the Bono Region is far better than that of Accra showed which stood at a prevalence of 21.4% (ADU-BONSAFFOH et al., 2017), and that of Kumasi which demonstrated an incidence of 17.04% (Owiredu et al., 2010).

#### **The Mode of Delivery amongst Women with HDP at the Bono Regional Hospital.**

The majority of the women with HPD 255 representing 82.3% had cesarean surgery as their mode of delivery. Those with Preeclampsia were the majority 195(76.5%) followed by Eclampsia which had 28 representing 10.9% and gestational hypertension being the least with 15 being 5.9%. For women with HPD who delivered through SVD, there were 55 number 17.7%. This finding is in contrast to the recommendations that vaginal delivery for preeclampsia at term is best by most international guidelines (Brown et al., 2000) but is in line with some recent studies which recommend induction of labor for cases of preeclampsia at term (Ben-Haroush et al., 2005). Also, the findings of this study contrast the findings of Xenakis et al which indicated or demonstrated an increased risk of failed induction of labor with a resulting increased risk of cesarean section (CS) in preeclamptics (Xenakis et al., 1997). This is because 52.6% of the majority of maternal deaths were women with eclampsia. Jia Li et al concluded that Delayed induction of labor with expectant monitoring may not be inferior to immediate induction of labor in terms of neonatal and maternal outcomes (Li et al., 2020). Varied cesarean rates as high as 100% in preeclamptics have been reported which can be attributed to the controversies regarding the timing and optimal mode of delivery in women with HDP (Pacher et al., 2014), this seems to explain the reason for which the majority of women being 82.3% with HPD delivered employing cesarean surgery in the Bono Region. However, these findings are in sharp contrast to the findings of Adu Bonsaffo and Sefa (2014) whose study in Accra showed the opposite trend where women with HPD delivered mostly by SVD (55%).

#### **Birth Outcomes of Women with HDP.**

Of the 4 women who had stillbirths 75% had preeclampsia and 25% had eclampsia. This puts the stillbirths at 1.3% which is below the 4.5% indicated by the WHO (2006) and that of Ethiopia which stands at 11.1%. 53.4% (166) the majority of the children born by women with HPD were doing well with 45.2% (140) in NICU. Eclampsia contributed to the majority of 52.6% (10) of maternal deaths caused by HPD, Preeclampsia on the other hand caused 31.6% (6) of the maternal deaths and other factors caused 15.9% (3). This reveals gestational hypertension is low among women in their fertility age and also is the least dangerous as it virtually caused no maternal death. Research indicating 50% of maternal mortality in Africa is caused by HPD (Berhan, 2016), therefore indicates that maternal deaths in the Bono Region are 84.1% caused by HPD which is very dominant and on the high side. It therefore can be concluded that HPD is the highest risk factor and determinant in maternal deaths of women in their fertility age in the Bono Region.

## 5. CONCLUSION

The prevalence rate of hypertensive disorders in the Bono region at **7.7%** is not the best but is quite a positive result. The rate is below the rate of the two most populous cities in Ghana, Accra (21.4%) and Kumasi (17.04%). With advanced nations like the United States, United Kingdom, and Australia having their prevalence rate of HDP in pregnancy ranging between 6 to 8 percent, 5.4 to 7 percent, and 8.2 percent respectively in prevalence rate, it can be concluded that the prevalence rate of hypertensive disorders in pregnancy is quite encouraging in the Bono Region. The study findings reveal that the dominant means or mode of delivery by women with hypertensive disorders in the Bono Region of Ghana is Caesarean surgery (82.3%). Preeclampsia is the most common hypertensive disorder in pregnant women in the Bono Region and also the highest contributor (76.5%) to Caesarean surgery as a mode of delivery. The dominant age of women with hypertensive disorders was between 20 and 35 years (70.6%). Finally, the birth outcomes also for pregnant women with hypertensive disorders in the Bono region concerning stillbirths show there is a relatively low risk of stillbirth with hypertensive disorders since the risk is at 1.3 % far below the world health rate of 4.5%. Hypertensive disorders according to this study cause 84.1% of maternal deaths in the Bono region and this is a cause of alarm.

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### Data Availability

Data used for this research is available upon request from the corresponding author.

### Notes

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