



## Prevalence and Predictors of Pre-Existing Hypertension among Prenatal Women: A Cross-Sectional Study in Ghana

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### Abstract

**Background:** We aimed to assess prevalence and predictors of pre-existing hypertension in pregnant women in three districts of Northern region, Ghana.

**Methods:** This cross-sectional study was conducted among 1626 women in the third trimester of pregnancy across four antenatal centers in 2018. A questionnaire was used to collect medical information including weight and height. We used descriptive statistics to characterize all qualitative variables and performed logistic regression analyses to estimate association of hypertension and other risk factors.

**Results:** We included 1626 women; mean age standard deviation (SD) of pregnant women was 27.4 (5.1) years. About 4.5% (95% confidence interval [CI]: 3.6-5.7) of pregnant women reported they had earlier been diagnosed of having hypertension by a doctor or midwife, before pregnancy. Obese pregnant women had 2.9 times increased adjusted odds of having hypertension relative to non-obese pregnant women (Odds Ratio (OR))=2.9, 95% [CI]: 1.39-5.85,  $P=0.004$ ). Further, gestational diabetes was a predictor of pre-existing hypertension at an increased odds of 4.9 times relative to those without gestational diabetes (OR= 4.9, CI: 0.92-26.75,  $P=0.061$ ). Women with two or more children had 3.2 times the adjusted odds of having hypertension (OR=3.2 CI: 1.59-6.69,  $P=0.001$ ).

**Conclusion:** Although the prevalence pre-existing hypertension was not too high, obesity, gestational diabetes and number of children were independent predictors of pre-existing hypertension in pregnant women.

**Keywords:** Antenatal care; Obesity; Hypertension; Gestational diabetes; Ghana

## Introduction



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Hypertension is an important public health phenomenon that continues to interfere with the normal course of the life span of pregnancy and beyond. Four main hypertensive disorders of pregnancy (HDP) are considered during pregnancy including gestational hypertension, preeclampsia-eclampsia; chronic hypertension and chronic hypertension with superimposed preeclampsia (1). Women with pre-existing hypertension are at an increased risk of complications from these four major hypertensive disorders (2,3).

In general, approximately, 5%-10% of women in their reproductive age have history of hypertension globally(4). In Africa, 12% of maternal deaths are associated with pregnancy-related hypertension (5) while 10% HDP occur among pregnant women; as a review revealed (6). A retrospective review conducted at the Korle Bu Teaching Hospital of Ghana showed that almost 32% of maternal deaths are related to hypertensive disorders (7).

Chronic hypertension (pre-existing hypertension) describes high blood pressure known to predate conception or detected before 20 wk of gestation (8). Chronic hypertension is suspected to complicate 2%-5% of pregnancies(1,9). Obesity and older age have been associated in the increasing prevalence of chronic hypertension (8,9). Furthermore, in Norway, 28.6% of hypertension prevalence was related to preeclampsia/eclampsia, gestational hypertension, preterm delivery, and pregestational or gestational diabetes mellitus (2). Additionally, women with diabetes had increased risk of developing hypertensive disorder in pregnancy (10–12). Again in Nigeria, obesity, gestational diabetes and parity were found to be significant risk factors of HDP(13). Moreover, hypertension, diabetes and obesity are linked to and can have separate or combined consequences to quality of life of a person (14). Therefore, pre-existing hypertension may have severe health consequences for the pregnant woman.

Pre-existing hypertension is included in the group of HDP and considering that most women wait till old age to have children in pursuit of personal and economic freedom (15,16), in the face of increased risk of hypertension with age (16), which is further compounded by the suggestion that 40% of pregnancies in Ghana are unplanned (17). Early detection of pre-existing hypertension may help to reduce hypertension-related complications that could arise as the pregnancy progresses. In particular, for nulliparous aged women as some studies identified nulliparity as a risk factor for pregnancy-associated hypertension (18).

This study aimed to assess prevalence and predictors of pre-existing hypertension in pregnant women in Ghana, to initiate early counseling and management for pregnant women.

## Methods

### Study area

Our study participants were third-trimester pregnant women from four antenatal centers of the selected hospitals in Ghana—Tamale Teaching Hospital, Tamale West Hospital, Tamale Central Hospital and the Savelugu Municipal Hospital all in the northern region of Ghana.

### Design

This was cross-sectional data collected in 2018 as a baseline for the fuel types respiratory and infant growth study (FRIGS), a multicenter prospective cohort study(19). Four hospitals (two primary hospitals, a secondary hospital and a tertiary hospital) were purposefully selected due to financial and proximal factors to aid easy tracking of participants and had all the urban and rural population mixes and other demographic features (residence and housing type, etc.) relevant for our exposure and outcomes variables.

We aimed to assess pre-existing hypertension of third-trimester pregnant women in the Tamale metropolis, Sagnarigu and Savelugu districts. A



research assistant (RA) had a one-on-one interview with the pregnant women using a structured questionnaire made up of two sections: general information and medical history. The questionnaire was evaluated and validated by expert panel and was piloted in 5% similar population in another hospital before the main study began. We interviewed 1626 women during that period. Our team included all women in their third trimester, carrying a singleton pregnancy (28 wk and above) at the four antenatal centers. We excluded pregnant women aided by an In-vitro Fertilization (IVF) and those with multiple pregnancies.

Relevant medical and obstetric history including the outcome variable (pre-existing hypertension i.e. if woman had ever been diagnosed with hypertension by a physician or midwife before or during pregnancy) were obtained from the antenatal records. Pre-existing hypertension entails high blood pressure known to predate conception or detected before 20 wk of gestation (8). However, since our inclusion criteria were 28wk and above, it was difficult to measure pre-existing hypertension data at the beginning of the study without relying on what a physician or midwife had previously diagnosed before pregnancy or before 20 wk gestation. Still, a blood pressure measurement was done with a blood pressure apparatus at the nurse's antenatal desk for hypertension on the same day of the interview, after which they were immediately sent to the RAs desk for the face-to-face interview. Data used were confirmed measurements by nurses.

Weight and height for body mass index (BMI) were measured in kilogram (kg) and centimeter (cm) at third trimester in the antenatal center using weighing scale and standard tape for height under the supervision of a nurse. A pregnant woman was considered obese if her BMI was greater than or equal to 30. Gestational diabetes was defined as a pregnant woman declared as having diabetes during the current pregnancy. Although we extracted this data from the records, they were confirmed cases from the midwife or physician after being properly diagnosed from laboratory by a two-hour 75 g oral glucose tolerance test (OGTT). Other information

gleaned from their records were maternal age, alcohol intake during or before pregnancy, medications before and during pregnancy. Most women were unwilling to disclose their age while others did not even know their age. As a result we had about 6% missing data for maternal age variable.

### *Sampling Method*

We used the convenient sampling method to select women in each of our hospitals. In collaboration with midwives in charges of the four antenatal centers, a third-trimester pregnant woman who completed her antenatal procedure for the day is sent to the research assistant's desk. RA after obtaining consent then screens the pregnant woman to determine if she meets the inclusion criteria of being a primary cook, non-smoker with single pregnancy. The pregnant woman was enrolled into the cohort and immediately face to face interview was conducted to obtain baseline data.

### *Sample size calculation*

$$2N = 4(Z_{\alpha} + Z_{\beta})^2 \bar{P}(1 - \bar{P}) / (P_2 - P_1)^2$$

Where; N= sample size

P<sub>1</sub>= risk of developing outcome or incidence rate in exposure to biomass

P<sub>2</sub>= risk of developing an outcome or incidence rate in non-exposed

Z<sub>β</sub>= Represents the probability of type 2 error

Z<sub>1.α/2</sub>= Represents the desired level of statistical significance (typically 1.96).

(P<sub>1</sub>-P<sub>2</sub>)<sup>2</sup>=effect size (the differences in proportions)

$\bar{P}$  = pooled proportion

$$P_2 = \frac{P_1}{RR} \quad P_1 = 0.07 \quad RR = 2$$

$$P_2 = \frac{0.07}{2} = 0.035$$

$$\bar{P} = \frac{P_1 + P_2}{2} = \frac{0.07 + 0.035}{2} = 0.0525$$

$$2N = 4(1.96 + 0.84)^2 0.0525(1 - 0.0525) / (0.035 - 0.07)^2 = 1273$$

Rounding up to the nearest 10, 1280. Therefore,  $2N=1280$ , we anticipated 15% loss to follow up. Therefore to augment this, we added 192 participants, approximately 15% of the total sample size  $N$ . Thus, we had 1472.

We exceeded 1472 by 154 due to some challenges we encountered in the field explained elsewhere (19), hence ending up with 1626 women for the baseline.

### Statistical Analysis

Stata 13 was used for the data analysis. Descriptive analysis was done for demographic characteristics and medical history. Frequencies and percentages were used to characterize all qualitative variables, while means and standard deviations were calculated for quantitative variables; we performed logistic regression analyses to estimate association of hypertension and other risk factors. In a univariate analysis, potential confounders were added into the logistic regression model, any variable that predicted preexisting was retained in the multiple logistic regression, significance was set at  $\alpha = 0.05$  for all the analyses, except for age. Although the  $P$ -value of age was greater than 0.05, we retained in the model given its importance as a confounder and its association with preexisting hypertension (20,21). We conducted a sensitivity analysis and found it to be significantly important in the model.

### Ethical approval

Approval was given by the Ethics Committees of Tehran University of Medical Sciences and Ghana Health Services with Ethical Numbers IR.TUMS.SPH.REC.1396.4066 and GHS-ERC: 010/12/17 respectively.

### Results

Table 1 shows general characteristics of the participants. We included 1626 pregnant women between the ages of 17 to 48, with mean age ( $\pm$ SD) of 27 (5.1). Almost 50.0% of pregnant women

were traders, 26.7% had no active jobs except for their house job. Regarding education, 45.7% of pregnant women had not been to school and 14.8% had at least diploma education. Of women 98.9% were either married or cohabiting, 89.3% of the women were from Mole-Dagomba ethnic clan. Less than a quarter of the women had three or more children with 38.5% having no child. Also, 15.3% of women were obese. Table 2 shows the medical history of the pregnant women. About 0.7% of women took alcohol between 2 to 3 times in a month before pregnancy, however; only about 0.4% of the women consumed alcohol at least 2 to 3 times in a month during pregnancy. Moreover, 4.5% of pregnant women reported they had ever been diagnosed by a doctor as having hypertension before pregnancy; this figure increased by 0.6% during current pregnancy. Further, 1.0% and 1.3% of women had ever been diagnosed by a doctor as having diabetes before and during pregnancy, respectively. Additionally, of the 4.5% having hypertension before pregnancy, 3.1% and 3.6% received blood pressure medications before and during pregnancy, respectively. In addition, 12.0% and 91.5% of women took folic acid before and during the current pregnancy respectively. Again, while 16.0% of women took multivitamins when they were not pregnant, 81.5% of them took multivitamins during pregnancy. Besides, 1.4% of the pregnant women were on family planning approaches before pregnancy. As illustrated in Table 3, our analysis revealed a significant association between pre-existing hypertension and obesity and number of children, as well as a marginal significance for gestational diabetes after adjusting for confounders. Consequently, we found a positive association between obesity and having hypertension even after adjusting for confounders. Moreover, women with gestational diabetes had higher odds of having pre-existing hypertension relative to those without gestational diabetes. Finally, women with two or more children increased odds of having pre-existing hypertension, these associations were after controlling for BMI, gestational diabetes, number of children and maternal age in a multiple logistic regression model.

Table 1: Characteristics of pregnant women

<i>Demographic Characteristics</i>	<i>N=1626</i>	<i>%</i>
Baby's Mothers/Pregnant women's occupation		
Non-employed	432	26.7
Government employee	136	8.4
Private sector	168	10.4
Laborer	73	4.5
Trader	808	50.0
Non-response	9	-
Baby's Mothers Educational level		
No education	743	45.7
Basic/Primary Education	421	25.9
Secondary/technical education	221	13.6
Diploma/HND/first degree	231	14.2
Postgraduate	10	0.6
Marital status		
Divorced	2	0.1
Married/living together	1604	98.9
Never married	11	0.7
Widowed	4	0.3
Non-response	3	-
Ethnicity		
Akan	13	0.8
Grusi	30	1.9
Guan	30	1.8
Gurma/Mande	13	0.8
Mole-Dagbani	1447	89.3
Other	87	5.4
Non-response	6	-
BMI (mean $\pm$ SD)	24.1 $\pm$ 5.32	
Under weight	216	13.4
Normal weight	738	45.9
Overweight	409	25.4
Obese	245	15.3
Non-response	18	-
Age (mean $\pm$ SD)	27.4 $\pm$ 5.1	n=1465
17-25	679	44.6
26-35	673	44.2
36-48	170	11.2
Non-response	104	-
Number of children (mean $\pm$ SD)	1.33 $\pm$ 1.42	
No child	632	38.9
2-3 children	670	41.2

3 or more children	324	19.9
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**Table 2:** History and risk factors among the pregnant woman

<i>Variable</i>	<i>Yes N=1626 Freq (%)</i>	<i>No Freq (%)</i>
Drunk alcohol months before pregnancy	11 (0.7)	1614 (99.3)
Drunk alcohol during this pregnancy	5 (0.4)	1621 (99.6)
Diagnosed of having hypertension before pregnancy (records)	74 (4.5)	1551 (95.5)
Diagnosed of having hypertension during pregnancy (confirmed examination)	84 (5.2)	1542 (94.8)
Diagnosed of having diabetes before this pregnancy	16 (1.0)	1609 (99.0)
Diagnosed of having diabetes during this pregnancy	21 (1.3)	1604 (98.7)
Medication/treatment taken before pregnancy		
Blood pressure pills	51 (3.1)	1574 (96.9)
Lipid/cholesterol lowering pills	3 (0.2)	1622 (99.8)
Insulin	7 (0.4)	1618 (99.6)
Folic Acid	199 (12.3)	1426 (87.8)
Multivitamins	261 (16.1)	1364 (83.9)
Antibiotics	149 (9.2)	1477 (90.8)
Family planning approaches	21 (1.3)	1626 (98.6)
Medication/treatment taken during pregnancy		
Blood pressure pills	59 (3.6)	1567 (96.4)
Insulin	9 (0.6)	1617 (99.4)
Folic Acid	1488 (91.5)	138 (8.5)
Multivitamins	1325 (81.5)	301 (18.5)
Antibiotics	203 (12.5)	1423 (87.5)
Other medication	9 (0.9)	1055 (99.1)

\*All variables in Table 2 have at most 2 missing data except other medications which had 562

**Table 3:** Univariate and multivariate analyses of risk factors for pre-existing hypertension in pregnant women

Variable	<i>Hypertension</i>		<i>Crude OR (95% CI)</i>	<i>P-value</i>	<i>Adjusted OR (95% CI)</i>	<i>P-value</i>
	Yes	No				
	BMI					
Non obese	52 (3.7)	1341 (96.3)	1	<0.001	1	0.001
Obese	193 (90.2)	21 (9.8)	2.8(1.65-4.76)		2.5 (1.46-4.43)	
	Non response					
Gestational diabetes						
No	68 (4.2)	1535 (95.8)	1		1	
Yes	15 (71.4)	6 (28.6)	9.0 (3.4-23.9)	<0.001	5.3(1.63-17.46)	0.006
No. of children						
0-1	34 (3.4)	959 (96.6)	1			
2 or more	40 (6.4)	583 (93.6)	1.9 (1.21 -3.09)	<0.001	1.83(1.11-2.99)	0.001
Maternal age						
Age			0.97(0.93-1.02)	0.212	0.98 (0.94-1.02)	0.266

\*BMI, gestational diabetes, number of children, age

## Discussion

Pregnancy and motherhood are supposed to be positive and fulfilling experiences, but for several women, it is associated with suffering, ill-health and even death. Although there has been improved global commitments to ensure that “every pregnant woman and newborn receives quality care throughout the pregnancy, childbirth and the postnatal period”(22), meaningful challenges persist and threaten maternal health.

Our analysis found the prevalence of pre-existing hypertension among pregnant women to be 4.5%, which is less than 7.5% as reported (23). Moreover, obesity, gestational diabetes and number of children were related to pre-existing hypertension. Hence, pregnant women with obesity, gestational diabetes and with two or more children had increased odds of having pre-existing hypertension. Another study also revealed an association between hypertension, diabetes and obesity and its consequences on the quality of life of persons (14). In a related study, women with at least one parental history of hypertension and diabetes had 3 times increased odds of developing preeclampsia (24). Again, in Ghana, obese women was found to be twice as likely to have hypertension compared to those with normal weight (21). More importantly, a study that assessed the impact of 2017 American College of Cardiology/American Heart Association high blood pressure guideline found the prevalence of hypertension increased by 112% among women of reproductive-aged in comparison with the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7) guideline (25). It therefore relevant since most of these women may not even know they have hypertension before getting pregnant, particularly in the least resourced countries like our study setting.

An explorative study showed that complications during pregnancy increase in women with hypertension irrespective of whether they have chronic hypertension or gestational hypertension (26). In Ghana, Amoakoh-Coleman et al reported of

about 3 times increased risk in hypertension in pregnancy for obese women (7). Similarly, obesity and family history of hypertension increased risk of pregnancy-induced hypertension (27).

Moreover, a conjoint association of gestational hypertension and gestational diabetes were found to increase the hazard of hypertension by 1.9 times (28), while women with chronic hypertension had increased risk of developing gestational diabetes (29). On parity, our findings agreed with a study conducted among African-American women, which found that women with a history of hypertension had more children compared to those without hypertension (30), and differed from a study among Asian-American women where nulliparity was significantly associated with pregnancy-associated hypertension (18). Similarly, a systematic review showed no significance with hypertensive disorders of pregnancy and number of children (31).

Given the changes in lifestyles especially where, today, women wait until later in life to have children (4) and the epidemiological shift towards the increasing trend in non-communicable diseases (NCDs). It is recommended to improve quality of antenatal care for effective transition through childbirth and ultimately to enable women to have a positive experience of motherhood(32). Thereby, surviving pregnancy and childbirth as part of their enjoyment of sexual and reproductive health and rights and living a life of dignity (33). Furthermore, women with pre-existing hypertension should be encouraged to take pre-pregnancy specialized care before conception(8). The strengths of this study include: our large sample size increases the chance of precision of the our estimate for hypertension that is important for policy interpretation and planning (34). On the other hand, we relied on one-time responses from participants through verbal diagnoses which could increase the possibility of recall bias and produce less accurate measure of obesity due to measuring weight at third trimester. We were also unable to consider different types of hypertension. Hence, we encourage further studies to include the weight of women be-

fore pregnancy and compare it with that of the third-trimester weight.

## Conclusion

Obesity, gestational diabetes and number of children were predictors of pre-existing hypertension among third-trimester pregnant women. Which suggests hypertension, like any other NCDs remains a public health challenge in the Northern Region of Ghana. Therefore, achieving the revolutionary sustainable development agenda – i.e. to reduce by one-third premature mortality from non-communicable diseases (including hypertension) through prevention and treatment by 2030 – would require proactively empowering women through innovative awareness creation and capacity building to address the risk factors of hypertension, especially through the primary health care approach, including during ANC visits.

## Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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## Conflict of interest

The authors have declared that they have no competing interest.

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