Knowledge of hypertensive disorders of pregnancy among pregnant women attending antenatal clinic at a tertiary hospital in Ghana

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Abstract

Objectives: Hypertensive disorders of pregnancy contribute significantly to maternal and neonatal morbidity and mortality globally. Health-seeking behaviour is influenced by adequate knowledge of the condition. However, current data on pregnant women’s knowledge of the condition and health-seeking behaviour are relatively scant in Ghana and has not been previously studied in the Central Region where hypertensive disorders of pregnancy was the leading cause of maternal mortality from 2016 to 2018. The study sought to generate data to fill this knowledge gap.

Methods: A cross-sectional study was conducted among 404 pregnant women attending antenatal clinic at the Cape Coast Teaching Hospital from 1 April to 30 September 2020. Data on sociodemographic characteristics, including age, level of education and parity, and knowledge of hypertensive disorders of pregnancy, including its risk factors, clinical presentations and complications, were collected using structured questionnaires. The outcome variable, knowledge of hypertensive disorders of pregnancy, was a composite variable categorized as adequate and inadequate knowledge. Descriptive statistics were generated and association between independent and outcome variables were explored using chi-square and Fisher’s exact tests and logistic regression methods.

Results: Sixty-two participants (15.4%) showed adequate knowledge of hypertensive disorders of pregnancy. About 62% (251/404) of respondents had heard about hypertensive disorders of pregnancy. Of those who had heard of hypertensive disorders of pregnancy, 29.4% (72/245) correctly indicated the condition was underlined by hypertension in pregnancy ≥ 20 weeks gestation. Women with tertiary education were six times more likely to have adequate hypertensive disorders of pregnancy knowledge than those with basic education. Women with parity 1–4 were 52% less likely to have adequate knowledge compared to nulliparous women.

Conclusion: The remarkably low proportion of pregnant women with adequate knowledge of hypertensive disorders of pregnancy in the study is worrisome because of its potential adverse implication for the health of mothers and their babies. Re-packaging the antenatal health education programme and its delivery is needed for greater impact as far as hypertensive disorders of pregnancy morbidity/mortality is concerned.

Keywords

Hypertensive disorders of pregnancy, knowledge, pregnant women, health-seeking behaviour, Ghana

Date received: 6 September 2021; accepted: 2 March 2022

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Introduction

Hypertensive disorders of pregnancy (HDP) constitute a public health problem with dire consequences for maternal and perinatal health. The condition complicates approximately 10% of pregnancies and underlies 14% of maternal deaths, 15% of perinatal deaths and 30% of maternal near-miss events globally. Chronic hypertension, gestational hypertension, preeclampsia/eclampsia and preeclampsia superimposed on chronic hypertension are the main categories of HDP. In sub-Saharan Africa, the prevalence of HDP was reported to be about 8%, and it accounted for up to 50% of maternal deaths between 2003 and 2014 with preeclampsia having the worst outcomes. More recent reviews have ranked HDP as the second leading cause of maternal deaths after obstetric haemorrhage in sub-Saharan Africa and the leading cause in the West African sub-region.

As part of its control, promotive health strategies such as antenatal care (ANC), clinics aim to equip pregnant women and their partners/relatives with adequate knowledge on the danger signs of pregnancy which reflect complications such as HDP. The desired outcome is early reporting immediately when they experience these danger signs so that prompt measures can be effected. The ANC clinics also present an opportunity for health workers to identify high-risk pregnant women with respect to HDP and other complications promptly for initiation of appropriate management. Ultimately, this will contribute to reducing the burden of perinatal/maternal morbidity and mortality. Studies have shown a general knowledge deficit regarding the symptoms, complications and impact of HDP among ANC attendants in Africa and Asia. About 42%–87% prevalence of inadequate or poor knowledge has been reported with the pregnant woman’s level of education, parity and a family history of hypertension being significantly associated with the adequacy of knowledge of HDP.

In Ghana, HDP has been noted as one of the leading causes of maternal deaths for well over a decade. An HDP prevalence of 21.4% has been reported with gestational hypertension and preeclampsia/eclampsia in the majority. HDP have also been noted to account for 37.3% of all maternal deaths, 50% of direct causes of maternal deaths and 20% of abortions and perinatal deaths in the country’s two largest hospitals. Furthermore, the incidence of pregnancy-induced hypertension (PIH) has been reported to be 6.1% and 3.2% in southern and northern Ghana, respectively. In spite of the significant local burden, data on the level of knowledge of the symptoms, danger signs and complications of HDP among ANC attendants or postpartum women are relatively scant. Close to 90% of ANC attendants have been reported to have inadequate or no knowledge of preeclampsia/eclampsia while up to 50% of postpartum women treated for preeclampsia/eclampsia had incomplete understanding of the condition despite being counselled on it. Higher educational levels have been noted to be significantly associated with the level of knowledge.

The Central Region of Ghana has a high burden of HDP and the regional health directorate’s annual health performance reports for 2016, 2017 and 2018 showed HDP was the leading cause of maternal mortality over those years. Knowledge of HDP among ANC attendants at the Central Coast Teaching Hospital (CCTH) in the region and the factors influencing it were assessed to help provide current data on pregnant women’s knowledge of the condition. In addition, the study is expected to enable better insight into the adequacy of ANC health education regarding HDP. This knowledge can be used to inform appropriate systemic changes to improve maternal and newborn well-being.

Methodology

Study area, design and procedures

A cross-sectional study was conducted from 1 April to 30 September 2020 to assess the knowledge of pregnant women attending ANC clinic at CCTH on HDP, their risk factors, clinical presentation, complications and their primary intervention when they experience symptoms or signs.

The CCTH in the Central Region serves as the main referral facility for the Central, Western and Western North Regions of Ghana, and parts of the Ashanti and Greater Accra Regions. According to the hospital records, CCTH records an average of over 8000 antenatal visits in a year with annual deliveries of over 3000 and HDP has been a leading cause of maternal/perinatal morbidity and mortality over the last decade (Biostatistics Unit, CCTH, 2020).

Pregnant women attending antenatal clinic at CCTH within the study period, irrespective of age, gravidity and gestational age, were included in the study. Women who presented with moderate-to-severe illness and those who could not communicate in English or the predominant local Fante/Twi languages were excluded but these were rather few.

A structured questionnaire (see Supplementary file) was developed de novo from literature review by the investigators. The questionnaire comprised eight sections and collected data on participant demographics, including age, parity and level of education; medical and drug history; general knowledge on HDP and its risk factors; clinical presentation; complications; primary interventions for HDP; and prevention of HDP. Midwives at the ANC clinic were trained over 2 days to administer the questionnaire in English or the local Fante/Twi languages after obtaining written informed consent. The training process emphasized uniformity in language translation for the questions. The questionnaires were administered when the clients were done with the processes at the antenatal clinic and were about to leave the facility. The questionnaire was pretested using 20 pregnant women attending ANC at a near-by health facility (the Cape Coast Metropolitan Hospital) and appropriate changes made to its structure.
**Sample size calculation**

The proportion of pregnant women with adequate knowledge on HDP in a Ghanaian study was 11.4%.\textsuperscript{10}

Thus, using the Cochran formula

$$n_0 = \frac{Z^2 pq}{e^2}$$

where, ‘$n_0$’ is sample size; ‘$Z$’ is confidence level (at 95%; \(1.96\)); ‘$p$’ is the proportion of the population with adequate knowledge on HDP in Ghana, which was 11.4%; ‘$q$’ is \(1 - p\); and ‘$e$’ is error margin (5%), a sample size of 156 was obtained. This was then adjusted upwards by 30% to account for anticipated non-response and the final sample size estimated for the study came to 223.

However, following the first cases of COVID-19 in Ghana in mid-March 2020, there was a drastic reduction in physical antenatal attendance, and a resort to telephone consultation for stable clients was adopted. It was thus decided to include all consenting pregnant women making physical visits from 1 April to 30 September 2020, and a total of 404 participants were recruited over the period.

**Statistical analysis**

Data were double-entered in SPSS version 21 (IBM, USA), cleaned and coded. It was exported to and analysed using Stata version 14 (College Station, TX, USA). Frequencies, percentages and means were generated and presented in tables. Participants’ responses to questions (see questionnaire in Supplementary file) bordering on whether they have heard of HDP and what it is (section 3), its risk factors (section 4), signs and symptoms (section 5), what is to be done if one experiences these signs and symptoms (section 6), complications of HDP (section 7) and what can be done to help prevent HDP (section 8) were scored as 1 for a correct answer and 0 for a wrong answer. The scores for the mentioned sections were 1, 7, 8, 1, 6 and 4 marks, respectively, and these gave a possible total correct score of 27 marks. Questions with more than one correct answer were scored 1 for each correct answer. The composite primary outcome variable, knowledge of HDP, was expressed as a proportion with the numerator as the participant’s correct scores and the denominator being the total score of 27 marks. This was converted into a percentage and grouped as ‘adequate knowledge’ (≥60%) and ‘inadequate knowledge’ (<60%). The variables feeding into the composite outcome variable were all deemed equally important and no weighting was done. The choice of the 60% cut-off was by the investigators’ discretion and informed by a desired need for pregnant women to have reasonably sufficient knowledge of HDP given its significant contribution to maternal/perinatal morbidity and mortality.

Association between the independent variables age, educational status, marital status, occupation and other demographic characteristics and participants’ knowledge level of HDP was tested using chi-square and Fisher’s exact tests, and variables showing significant association were entered in a logistic regression model to assess the strengths of the associations. Crude and adjusted odds ratios (ORs) were reported with 95% confidence intervals (CIs). An association between the explanatory and dependent variables was deemed significant if the p value was <0.05. For the variable ‘Educational Status’, the category ‘basic education’ was made the reference population because the number of participants with no formal education, which was the default with Stata, was relatively small.

**Ethical considerations**

Ethical approval for the study was granted by the Institutional Review Board of the University of Cape Coast (reference number: UCCIRB/CHAS/2019/163) and the Ethical Review Committee of the CCTH (reference number: CCTHERC/EC/2020/016). Written consent was obtained from the study participants. Anonymity and confidentiality were ensured as no personal identifiers were used. For participants under 18 years of age, the Ethics Committee waived the requirement of obtaining consent from authorized representatives on account of the fact that getting these representatives was going to be a challenge since pregnant teenagers mostly attend the ANC unaccompanied in our setting.

**Results**

**Participants’ background characteristics and past medical history**

Table 1 shows the demographic characteristics of the study participants. About four in five participants (81.9%, 326/398) were married. Those in the age group 30–39 years constituted the largest proportion (52.7%, 213/404). Respondents in formal employment constituted 42.3% (171/404) while 68.8% (251/365) of respondents earned a monthly income above the minimum wage of Gh₵350.00 (US$62.5). Fourteen of the participants (3.5%) had no formal education while 52.2% (211/404) had tertiary-level education. Majority of the respondents had parity of 1–4 (62.8%, 208/331). Twenty-five out of the 404 participants (6.2%) had hypertension while 3.5% (14/404) had sickle cell disease (see Supplementary Table 1). None of them was diabetic.

**Knowledge on HDP**

Sixty-two participants (15.4%) showed adequate knowledge of HDP while 84.6% (342/404) showed inadequate knowledge.

Table 2 presents data on participants who had heard of HDP and its risk factors. About 62% (251/404) of the pregnant women reported they had heard about HDP. Of these, about 45% (114/251) had heard about it from antenatal
clinics while a little over 50% (132/251) wrongly described HDP as hypertension with or without pregnancy or hypertension in pregnancy below 20 weeks gestation. Of the 251 women who had heard about HDP, 72 (28.7%) correctly indicated it was hypertension in pregnancy after 20 weeks. Of the respondents who had heard of HDP, 44.6% (112/251), 60.2% (151/251) and 33.5% (84/251), respectively, knew that a past medical history of HDP, family history of HDP and a history of chronic hypertension are risk factors for HDP (see Table 2). About a third of this sub-group (33.1%, 83/251) knew age is a predisposing factor.

Table 3 presents responses on knowledge of symptoms, signs and complications of HDP and their health-seeking behaviour among participants who had heard of HDP. About 62% (155/251) and 60% (151/251) knew of headaches and facial/pedal swelling while about 14% (35/251) identified abdominal pain as a symptom. Over 80% (210/251) indicated they would go to a health facility on experiencing any of the symptoms and signs listed in the questionnaire. Less than 50% were aware it could lead to reduced foetal movements (95/251), foetal growth abnormalities (78/251), seizures (93/251) and maternal mortality (122/251), respectively. However, 53.4% (134/251) were aware it could cause foetal death.

Frequent antenatal assessments at the clinic, sufficient rest and eating healthy diet were some HDP prevention

Table 1. Demographic characteristics of study participants.

| Factors             | Adequate knowledge n (%) | Inadequate knowledge n (%) | p value |
|---------------------|--------------------------|----------------------------|---------|
| Age                 |                          |                            |         |
| <20                 | 1 (8.3)                  | 11 (91.7)                  | 0.400a  |
| 20–29               | 27 (17.4)                | 128 (82.6)                 |         |
| 30–39               | 33 (15.5)                | 180 (84.5)                 |         |
| 40+                 | 1 (4.2)                  | 23 (95.8)                  |         |
| Relationship status |                          |                            | 0.426   |
| Single              | 9 (12.5)                 | 63 (87.5)                  |         |
| Married             | 53 (16.3)                | 273 (83.7)                 |         |
| Occupation          |                          |                            |         |
| Unemployed          | 7 (9.7)                  | 65 (90.3)                  | <0.001  |
| Formal employmentb | 44 (25.7)                | 127 (74.3)                 |         |
| Informal employmentc| 11 (6.8)                 | 150 (93.2)                 |         |
| Monthly income$$d$$ |                          |                            | <0.001a |
| $<$GHC350.00        | 5 (5.7)                  | 83 (94.3)                  |         |
| GHC350.00           | 1 (3.9)                  | 25 (96.2)                  |         |
| $>$GHC350.00        | 53 (21.1)                | 198 (78.9)                 |         |
| Religion            |                          |                            | 0.136a  |
| Christian           | 59 (16.7)                | 294 (83.3)                 |         |
| Muslim              | 3 (6.5)                  | 43 (93.5)                  |         |
| Othere              | 0 (0.0)                  | 5 (100.0)                  |         |
| Educational status  |                          |                            | <0.001a |
| No formal education | 1 (7.1)                  | 13 (92.9)                  |         |
| Basic educationf   | 5 (4.4)                  | 110 (95.7)                 |         |
| Senior high school  | 3 (4.7)                  | 61 (95.3)                  |         |
| Tertiary            | 53 (25.1)                | 158 (74.9)                 |         |
| Parity of respondents|                       |                            | 0.031a  |
| 0                   | 25 (23.2)                | 83 (76.9)                  |         |
| 1–4                 | 25 (12.0)                | 183 (88.0)                 |         |
| 5+                  | 2 (13.3)                 | 13 (86.7)                  |         |
| Partner (n = 356)g  |                          |                            | 0.098   |
| New partner         | 6 (8.6)                  | 64 (91.4)                  |         |
| Old partner         | 47 (16.4)                | 239 (83.6)                 |         |

*Fisher’s exact p value reported.

*Includes civil/public servants and those in the corporate work environment.

*Traders, farmers, fishmongers, artisans and other forms of self-employment.

*GHC 350 (USD 62.50 per the exchange rate over the period of the study) is the equivalent of the minimum monthly wage in Ghana for 2020.

*Include Buddhism, Traditionalist and non-religious people.

*Basic education, in Ghana, entails primary to junior high school level.

*Old partner is one with which a respondent has a child or children with already while a new partner is one with which a respondent is yet to have a child with.
methods indicated by 78.1% (196/251), 50.2% (126/251) and 57.4% (144/251) of the respondents, respectively.

**Factors influencing knowledge of HDP**

The chi-square and Fisher’s exact analyses showed occupation ($p < 0.001$), monthly income ($p < 0.001$), educational status ($p < 0.001$) and parity ($p = 0.031$) were significantly associated with participants’ level of knowledge of HDP (see Table 1).

In the bivariate logistic regression analysis (see Table 4), women in formal employment were three times more likely to have adequate knowledge of HDP ($\text{OR} = 3.22$, 95% CI: 1.37–7.54; $p = 0.007$) compared to those who were unemployed. Those in the informal sector were 32% less likely to have adequate knowledge ($\text{OR} = 0.68$, 95% CI: 0.25–1.84; $p = 0.447$) compared to the unemployed, but this was not statistically significant. Participants earning above GHC350 monthly had at least four times ($\text{OR} = 4.44$, 95% CI: 1.71, 11.51; $p = 0.002$) the odds of having adequate knowledge of HDP compared to those earning less than that amount. Respondents with parity 1–4 were less likely to have adequate knowledge ($\text{OR} = 0.45$, 95% CI: 0.25–0.84; $p = 0.011$) compared to nulliparous women. There was no statistically significant difference between grand

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| Variable | Frequency | Percentage |
|----------|-----------|------------|
| Heard about hypertensive disorders of pregnancy (N=404) | | |
| Yes | 251 | 62.1 |
| No | 153 | 37.9 |
| If yes, where did you hear about it (n=251) | | |
| Family | 27 | 10.8 |
| Friend | 17 | 6.8 |
| Media | 63 | 25.1 |
| Antenatal clinic | 114 | 45.4 |
| Other* | 30 | 12.0 |
| What is hypertensive disorders of pregnancy (n=245) | | |
| Hypertension with or without pregnancy | 98 | 40.0 |
| Hypertension below 20 weeks*b | 34 | 13.9 |
| Hypertension after 20 weeks | 72 | 29.4 |
| Don’t know | 41 | 16.7 |
| What predisposes one to hypertensive disorders in pregnancy? (n=251) | | |
| Hypertensive disorder of pregnancy in previous pregnancy | | |
| Yes | 112 | 44.6 |
| No | 139 | 55.4 |
| Family history of hypertensive disorder of pregnancy | | |
| Yes | 151 | 60.2 |
| No | 100 | 39.8 |
| Chronic hypertension | | |
| Yes | 84 | 33.5 |
| No | 167 | 66.5 |
| Obesity | | |
| Yes | 129 | 51.4 |
| No | 122 | 48.6 |
| Lack of exercise | | |
| Yes | 83 | 33.1 |
| No | 168 | 66.9 |
| Stress | | |
| Yes | 112 | 44.6 |
| No | 139 | 55.4 |
| Age | | |
| Yes | 83 | 33.1 |
| No | 168 | 66.9 |
| Don’t know | 43 | 17.1 |

HDP: hypertensive disorders of pregnancy.

*Health education in church.

bWhile acknowledging atypical cases of HDP have been seen below 20 weeks, we are maintaining HDP as hypertension from 20 weeks onwards in this study.
Table 3. Knowledge of clinical presentation and complications of HDP and attendant health-seeking behaviour among respondents who had heard of HDP.

| Variable | Frequency (n=251) | Percentage (%) |
|----------|-------------------|----------------|
| What are the signs or symptoms of HDP? | | |
| Sudden weight gain | | |
| Yes | 74 | 29.5 |
| No | 177 | 70.5 |
| Swelling of face and feet | | |
| Yes | 151 | 60.2 |
| No | 100 | 39.8 |
| Headache | | |
| Yes | 155 | 61.8 |
| No | 96 | 38.2 |
| Foamy urine | | |
| Yes | 35 | 13.9 |
| No | 216 | 86.1 |
| Abdominal pain | | |
| Yes | 35 | 13.9 |
| No | 216 | 86.1 |
| Decreased urine output | | |
| Yes | 65 | 25.9 |
| No | 186 | 74.1 |
| Nausea vomiting | | |
| Yes | 33 | 13.1 |
| No | 218 | 86.9 |
| Difficulty breathing | | |
| Yes | 37 | 14.7 |
| No | 214 | 85.3 |
| Don’t know | 55 | 21.9 |

Primary intervention for the signs

| Variable | Frequency (n=251) | Percentage (%) |
|----------|-------------------|----------------|
| What would you do if you experience any of these signs? | | |
| Take some rest | | |
| Yes | 103 | 41.0 |
| No | 148 | 59.0 |
| Take over the counter medicine | | |
| Yes | 3 | 1.2 |
| No | 248 | 98.8 |
| Go to a faith healer | | |
| Yes | 1 | 0.4 |
| No | 250 | 99.6 |
| Go to the herbalist | | |
| Yes | 1 | 0.4 |
| No | 250 | 99.6 |
| Go to the health centre or hospital | | |
| Yes | 210 | 83.7 |
| No | 41 | 16.3 |
| Don’t know | 24 | 9.6 |

Complications of HDP

| Variable | Frequency (n=251) | Percentage (%) |
|----------|-------------------|----------------|
| What are the complications of HDP? | | |
| Decreased foetal movement | | |
| Yes | 95 | 37.8 |
| No | 156 | 62.2 |
| Foetal growth abnormalities | | |
| Yes | 78 | 31.1 |
| No | 173 | 68.9 |

(Continued)

Table 3. (Continued)

| Variable | Frequency (n=251) | Percentage (%) |
|----------|-------------------|----------------|
| Foetal death | | |
| Yes | 134 | 53.4 |
| No | 117 | 46.6 |
| Confusion | | |
| Yes | 48 | 19.1 |
| No | 203 | 80.9 |
| Seizures | | |
| Yes | 93 | 37.1 |
| No | 158 | 62.9 |
| Death of mother | | |
| Yes | 122 | 48.6 |
| No | 129 | 51.4 |
| Don’t know | 58 | 23.1 |

Prevention of HDP

| Variable | Frequency (n=251) | Percentage (%) |
|----------|-------------------|----------------|
| Regular ANC visits for assessment | | |
| Yes | 196 | 78.1 |
| No | 55 | 21.9 |
| Take enough rest | | |
| Yes | 126 | 50.2 |
| No | 125 | 49.8 |
| Eat healthy diet | | |
| Yes | 144 | 57.4 |
| No | 107 | 42.6 |
| Exercise during pregnancy | | |
| Yes | 100 | 39.8 |
| No | 151 | 60.2 |
| Faith healers | | |
| Yes | 1 | 0.4 |
| No | 250 | 99.6 |
| Herbal medications | | |
| Yes | 2 | 0.8 |
| No | 249 | 99.2 |
| Don’t know | 43 | 17.1 |

HDP: hypertensive disorders of pregnancy; ANC: antenatal care.

Discussion

HDP account for 14% of maternal mortality globally with about 99% of these deaths occurring in developing
Driven by a high burden of HDP morbidity and mortality in the Central region of Ghana and a need for current data, the study assessed, for the first time, the knowledge of HDP among ANC attendants at the CCTH. This is relevant as the level of knowledge, awareness and perception of health-related issues drive health-seeking behaviour and ultimately impact health outcomes.

About 85% of study participants had inadequate knowledge on HDP and this is similar to previous findings in Nigeria, Ghana and India. Against a background of previous study findings in other parts of Ghana, the current study’s finding of about 85% prevalence of inadequate or poor knowledge of HDP suggests the burden may be more widespread. This observation is worrisome as inadequate knowledge of HDP underlies challenges for early recognition of danger signs and subsequent poor health-seeking behaviour. In this context, one may not be too wrong in predicting that the proportion of HDP-attributable maternal deaths in Ghana will persist and even increase in the near future.

The reasons for the high prevalence of inadequate HDP knowledge observed in the present study are unclear and require further exploration to unearth potential underlying factors that can ultimately be used to design appropriate health promotion interventions. Possibly, the manner in which antenatal health education in our setting is typically given once, en masse, before the clinic starts with little opportunity for repetitions or reinforcement may be disadvantageous and does not lend to sufficient understanding and interpretation of information given. For such a situation, antenatal education delivery methods must be reviewed to emphasize understanding by allowing for greater health worker–ANC attendant interaction during the session, for instance. In addition, appropriately designed videos illustrating the pathological pathways and complications of HDP can be useful. Adult learning is more effective with a blend of visual and auditory approaches.

About 40% of the respondents reported they had not heard of HDP, similar to findings in other studies. However, one must interpret this finding with caution because in addition to primigravidae who may genuinely not know about HDP, this sub-group included multigravidae who have previously attended antenatal clinics and most likely would have received some education on HDP. It is likely this latter group did not thoroughly understand or appreciate the education they may have received on HDP and its implications, similar to previous observations.

Similar to previous studies, less than 50% of the pregnant women who had heard of HDP did so from antenatal clinics. Much as the other sources including family and friends, the media and health education in churches are important, this suggests that there may be gaps in the role of ANCs as key providers of health education on conditions affecting pregnant women including HDP. These gaps must be explored and addressed as part of maternal and child health improvement measures. It could also reflect poor ANC attendance but this is not likely to be the case as >95% of women in Ghana attend ANC at least once during their pregnancy.

In the present study, 62% of respondents had heard about HDP and is comparable to findings regarding PIH in Ethiopia.
but lower than the 100% and 82%, respectively, reported in the Tamale metropolis in Ghana and in South-West Nigeria.\textsuperscript{13,31,33} It is not clear why our finding is markedly lower than those from Tamale and South-West Nigeria though all three were hospital-based and conducted in urban communities with participants having similar sociodemographics. The difference could be from variations in the frequency of ANC attendance and style of health education delivery, and these must be explored for better understanding of issues.

Women who had heard about HDP (about 62% of study subjects) identified at least one risk factor for HDP. While this looks encouraging, it also needs cautious interpretation as more than half of them could not identify the other risk factors aside family history of HDP and obesity. Similarly, more than half could not identify other signs and symptoms of HDP aside swelling of hands/feet and headaches.

An encouraging finding is the 83.7% of participants who indicated they will report to a health centre should they encounter any of the signs and symptoms listed in the questionnaire. However, there is concern over the 16.3% who would not go to a health facility as this is the population likely to produce severe HDP morbidity and deaths. Community health nurses, during their home visits, must consciously seek out such pregnant women and counsel them to attend antenatal clinics. Moreover, the use of community pregnancy registries in tracking ANC attendance can be beneficial if properly implemented.

The present study observed that pregnant women with tertiary level of education were approximately six times more likely to have adequate knowledge on HDP compared to those with basic level of education. Previous studies observed higher or adequate HDP knowledge with higher education.\textsuperscript{10,12,14} Higher education is expected to translate into better health information access, comprehension and assimilation. The findings relating to higher education must be interpreted with caution as the CIs around the OR estimates (crude and adjusted) for tertiary education are rather wide and suggest reduced precision. It must be noted that the educational status category with the least numerical label, ‘no formal education’, was not used as the reference category in the logistic regression because of the small numbers in that category. Using it would not have been wrong inherently and would have resulted in different ORs being reported.\textsuperscript{34} However, the relatively small number in that category would likely have been associated with larger standard errors and wider CIs than even those reported.\textsuperscript{34}

Monthly earnings in excess of GH₵350 showed borderline association with the outcome variable in the bivariate but not multivariate analysis. Its initial effect was likely due to the effect of confounding variables such as education, parity and other characteristics that may not have been assessed in the present study. Low wealth status has been observed to be significantly associated with poor awareness of PIH among pregnant women.\textsuperscript{13}

In the current study, women in the parity category of 1–4 were 52% less likely to have adequate HDP knowledge compared to nulliparous women. Contrary to the present finding, higher parity has been reported to be associated with adequate knowledge on HDP.\textsuperscript{12,14} Higher parity may offer the advantage of repeated ANC visits and a greater likelihood of learning more about HDP. Nulliparity has been reported to be significantly associated with poor HDP knowledge in an Ethiopian study.\textsuperscript{13} It is unclear why women with parity 1–4 were less likely to have adequate HDP knowledge relative to nulliparous women when the former has presumably had previous ANC engagements where health education on HDP would likely have been given. A possible explanation is that they may not have adequately understood the health education they were given, similar to what was reported in another study in Ghana\textsuperscript{29} such that there was no significant difference in overall HDP knowledge level between them and the nulliparous group. This possible explanation seems to be supported by another finding in the current study where multigravid women, as part of a larger 40% of participants, reported they had not heard of HDP. Another study in Ghana\textsuperscript{29} also reported that 40% and 50%, respectively, of postpartum women showed incomplete understanding of preeclampsia and eclampsia though they had been counselled on the conditions. Inability to understand English alone is unlikely to be a reason for such inadequate understanding since the ANC activities are conducted in the local language and this reinforces the need for revisions to the strategy of delivering these life-saving health education messages.

Contrary to previous reports of occupation being associated with better knowledge on HDP,\textsuperscript{13,14} it did not have a significant association with knowledge level on HDP in the present study. It is unclear how occupation lends to better HDP knowledge and may only be a confounder as suggested in the regression analysis.

A strength of the study is that it used a sample size sufficiently large to assure confidence in the results obtained. The study is limited by the use of close-ended questions as these do not allow exploration of response choices regarding prevention, primary interventions and complications of HDP. Also, the study was conducted at a single centre and is thus of limited generalizability. A potential selection bias may arise because women who made physical visits to the ANC clinic and were recruited as study participants may differ in some characteristics from those who had telephone consultations. It is possible the latter group of women could have provided different answers and subsequently different study findings. While this may limit the study’s external validity, it must be noted that similar high proportions of pregnant women having no or low knowledge of HDP have been reported in other Ghanaian studies,\textsuperscript{10,25} and this increases confidence in the results reported.

Aside hypertension and sickle cell disease, a history of renal, thyroid and autoimmune diseases are other important
predisposing conditions, but these were not assessed in the study and is considered a limitation. Finally, the questionnaire used was not validated but it was piloted to improve reliability. In spite of these limitations, the findings highlight an important need to re-strategize HDP education delivered to pregnant women at ANC and are still relevant for public health practice.

**Conclusion**

Adequate knowledge of HDP among the participants was remarkably low. Attention must be paid to addressing this gap and to improving the education on HDP routinely provided at ANC. Messages targeting the danger signs and symptoms of pregnancy (of which HDP will be a part) in the dominant local languages must run on television, radio and social media for wide coverage. Further qualitative research to better appreciate the interpretations pregnant women have of HDP is needed to craft effective information, education and communication materials and strategies.

**Acknowledgements**

We are grateful to the study participants who graciously made time to talk to us.

**Ethical approval**

Ethical approval for the study was granted by the Institutional Review Board of the University of Cape Coast (reference number: UCCIRB/CHAS/2019/163) and the Ethical Review Committee of the Cape Coast Teaching Hospital (reference number: CCTHERC/EC/2020/016).

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**Informed consent**

Written informed consent was obtained from all subjects before the study. For participants under 18 years of age, the Ethics Committee waived the requirement of obtaining consent from authorized representatives on account of the fact that getting these representatives was going to be a challenge since pregnant teenagers mostly attend the ANC unaccompanied in our setting.

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**Supplemental material**

Supplemental material for this article is available online.

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