Measuring regional and district variations in the incidence of pregnancy-induced hypertension in Ghana: challenges, opportunities and implications for maternal and newborn health policy and programmes

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Abstract

OBJECTIVES   The objectives were to assess the quality of health management information system (HMIS) data needed for assessment of local area variation in pregnancy-induced hypertension (PIH) incidence and to describe district and regional variations in PIH incidence.

METHODS   A retrospective review of antenatal and delivery records of 2682 pregnant women in 10 district hospitals in the Greater Accra and Upper West regions of Ghana was conducted in 2013. Quality of HMIS data was assessed by completeness of reporting. The incidence of PIH was estimated for each district.

RESULTS   Key variables for routine assessment of PIH such as blood pressure (BP) at antenatal visits, weight and height were 95–100% complete. Fundal height, gestational age and BP at delivery were not consistently reported. The incidence of PIH differed significantly between Greater Accra region (6.1%) and Upper West region (3.2%). Prevalence of obesity among pregnant women in Greater Accra region (13.9%) was significantly higher than that of women in Upper West region (2.2%).

CONCLUSIONS   More attention needs to be given to understanding local area variations in PIH and possible relationships with urbanisation and lifestyle changes that promote obesity, to inform maternal and newborn health policy. This can be done with good quality routine HMIS data.

keywords   routine data, decision making, maternal and newborn health, pregnancy-induced hypertension, local area variation

Introduction

Hypertensive disorders of pregnancy (HDP) are important causes of maternal and perinatal morbidity and mortality globally. They include pregnancy-induced hypertension (PIH), pre-eclampsia, eclampsia and the HELLP (Haemolysis, Elevated Liver enzymes, Low Platelets) syndrome. A World Health Organisation (WHO) systematic review concluded that with 50 000 annual deaths, hypertensive disorders are one of the major causes of maternal mortality, particularly in low- and middle-income countries (LMICs). In that report, HDP were the third leading cause of maternal deaths (9.1%) in Africa and the leading cause of death in Latin America and the Caribbean accounting for 25.7% of mortality [1].

The underlying causes of HDP are not fully understood but hypothesised to be related to poor placentation and feto–maternal interactions [2]. A number of individual risk factors are known to be associated with the condition [3, 4] including maternal age, obesity, ethnicity, nulliparity, multiple pregnancy, diabetes mellitus and family history of hypertension or PIH.

In Ghana, HDP are the third leading cause of maternal deaths (9%) after haemorrhage (22%) and induced abortion (11%) [5]. However the incidence of HDP does not appear to be uniform across the country. The Ghana Maternal Health Survey conducted in 2007 found that in highly urbanised Accra, the capital city, HDP were more common, accounting for 19% of all maternal deaths [5]. A retrospective study of maternal deaths at the Komfo

Anokye Teaching Hospital in Kumasi, Ghana between January 2008 and June 2010 found that HDP were the leading cause of institutional mortality, accounting for 26.4% of all maternal deaths [6], and having overtaken haemorrhage as the major cause of death in pregnant women.

There is very little information about the extent of and the reasons why there would be rural, urban and other geographical area variation in the incidence and prevalence of the condition in sub-Saharan African countries. It is possible that in addition to individual factors, there may be environmental and contextual risk factors such as urbanisation and lifestyle factors associated with the condition.

Observations of variations in the incidence and prevalence of HDP are not new, but the data are mainly from other parts of the world. A WHO study on the geographical variation of the incidence of hypertension in pregnancy in Asia found that it varied by a factor of 25 between countries [7]. The study concluded that there are genuine differences in the incidence of HDP in the populations of South East Asia and that these are not caused by underlying differences in the baseline blood pressures (BP) in these populations. A similar study is not available for sub-Saharan Africa or for individual countries within the region despite it being important to understand the extent of any geographical variations in HDP prevalence and factors contributing to such variation. It has implications for the development and implementation of clinical and programmatic interventions that can contribute to the reduction of HDP to maternal, foetal and newborn morbidity and mortality.

Antenatal and delivery data management at the health facility level in Ghana

All antenatal and delivery information in Ghana is kept in the individual maternal health record book of each woman. This includes personal information and information on services received including laboratory results. The maternal record books are not retained in the clinic as the women take them home with the advice to carry them to any clinic they may need to visit. At each visit, the attending nurses at the antenatal clinic (ANC) and labour wards enter key information about the woman's care into the antenatal register or the delivery register. Which of the data entered into the maternal health record book is extracted into the antenatal and the delivery register is determined at the national level and conveyed to frontline staff in all health facilities. It is also integrated into the design of the antenatal and delivery registers. Thus any patient information, which is not

required to be entered into these registers, is effectively lost to routine health management information system (HMIS) data once patients leave the clinic with their records.

The availability of high quality routine HMIS data can make mapping of local area variations in the incidence of a condition such as PIH, as well as tracking changes over time, a relatively simple task. It is however, uncertain whether the quality of the routine HMIS data permits its use for such a purpose. We decided to carry out an initial exploration to answer some of these questions.

Aims of the study

Our study had two aims. The first was to assess the availability and completeness of district and facility level routine HMIS data in Ghana that would enable a mapping of PIH incidence on a routine basis. The second was to describe the extent to which the data allow to study variation in the incidence of PIH between urban and rural districts in Ghana and explore some of the possible maternal, contextual and environmental factors that might explain these variations.

For the second aim, we hypothesised that there are statistically significant variations in incidence of PIH across regions and districts in Ghana with the incidence of PIH being higher in highly urbanised areas compared to less urbanised and rural areas. We further theorised that these variations would possibly be explained in part by a higher prevalence of obesity in higher incidence PIH geographical localities. This is because urbanisation is often accompanied by changes in critical lifestyle factors known to favour the development of obesity.

Methods

The study was a retrospective record review of ANC and delivery records of 2682 pregnant women using district hospitals in the Greater Accra ($n = 1578$) and Upper West ($n = 1104$) regions of Ghana in the first half of 2012. We used ANC records since based on community surveys and routine HMIS data we consider that they are reasonably representative of the population of pregnant women in the community.

With regard to ANC coverage rates, the Ghana Maternal Health Survey, 2007 [5] reported ANC coverage for the various regions in Ghana ranging from 91.7% to 98.7% and reported ANC coverage of 96.4% and 94.3% for the Greater Accra and the Upper West regions, respectively. The 2008 and the 2014 Ghana Demographic and Health surveys [8, 9] providing aggregate regional

data, show over 95% ANC attendance across the country, including the two regions studied. Routine HMIS data of the Ghana Health Service similarly show over 95% ANC attendance at the aggregate regional level. Routine Ghana Health Service data on district level show district by district variation ranging from 56.4% to 135.5% in the Upper West region and 45.4% to 172.1% in the Greater Accra region [10]. The district by district variation in ANC coverage is in part accounted for by women crossing borders to use clinics in neighbouring districts rather than lower community-based use rates of antenatal care, resulting in ANC coverage rates exceeding 100% for some districts.

For all pregnant women, individual patient data were obtained for the first ANC visit to give baseline characteristics of the women at the onset of their pregnancy and for subsequent ANC visits to delivery where available. To facilitate explanation of the findings, observation within the clinics and unstructured discussions and conversations with the staff were also conducted.

We purposely selected the Greater Accra and the Upper West regions for the conduct of this study based on the Ghana Statistical Service data that showed that Greater Accra is the most urbanised region in Ghana (90.5% urbanisation) with the lowest aggregate poverty levels (12% poverty prevalence), whereas Upper West is the least urbanised region in Ghana (16.3% urbanisation) with some of the highest aggregate poverty levels (88% poverty prevalence) in the country [11, 12]. The two extremes of rural and urban were chosen to assess the theory that variations in PIH across Ghana may in part be explained by urbanisation and the accompanying lifestyles changes that favour the development of obesity.

Within each region, the inclusion criteria for districts in the study were that the district should have a district hospital and the hospital management team should agree to participate in the study. Out of 11 districts in the Upper West Region, eight met the inclusion criteria and formed the sampling frame. Five districts were randomly selected through balloting. Of the 16 districts in the Greater Accra Region, nine met the inclusion criteria and constituted the sampling frame out of which five were randomly selected through balloting. The selection of five districts per region was based on resources available to conduct the study and the need to have a minimum of four units of randomisation (district with a district hospital) in each region.

Within each district, the inclusion criteria for women in the study were being pregnant, and presenting with normal BP at the district hospital ANC visits before 20 weeks of gestation for a routine antenatal rather than a referred antenatal visit. Pregnant women in the selected districts with pre-existing hypertension or who developed hypertension before 20 weeks of gestation were excluded. The primary outcome measure, PIH, was defined as systolic BP (SBP) of 140 mmHg or more and/or a diastolic BP (DBP) of 90 mmHg or more on at least two occasions, 4 hours apart, and present for the first time after 20 weeks of pregnancy [13].

Data on pregnant women who attended the health facility from 1 January 2012 to 30 June 2012 were extracted from the antenatal and maternity registers and recorded on a checklist. These registers are facility level summary listings of key clinical variables and information on all pregnant women who have used the ANC and delivered at their facility. Data on weight, height, gestational age, fundal height, weight and BP at first and subsequent antenatal visits were obtained from the antenatal register. Body mass index (BMI) was calculated by dividing the weight in kilograms by the squared height in metres of the woman. Data on mode of delivery, and delivery outcome was obtained from the maternity/delivery register. We also searched the laboratory registers of the hospitals to obtain data on urine testing for protein and the delivery records and nurses notes for data on BP measurements at delivery.

Data analysis

Data were analysed using IBM SPSS Statistics 20 (IBM Corporation, New York City, USA, 2011). We compared characteristics of pregnant women from the Upper West and Greater Accra regions. Data on categorical variables were presented by frequencies and percentages. Continuous data were presented as means with standard deviation (SD).

Student's *t*-test was used to assess whether there were significant differences in means between the pregnant women in the two regions and reported significant with a P-value of <0.05. The WHO BMI classification of underweight <18.5, normal weight 18.5–24.9, overweight 25.0–29.9 and obese ≥ 30 was used to categorise women in the study [14]. Chi-squared test was used to assess differences in categorical variables between the two regions. Analysis of covariance was used to test whether there were differences in BMI, SBP and DBP between districts and the regions after adjusting for gestational age. To estimate the incidence of PIH, the numerator was the number of pregnant women who developed PIH and the denominator was the total number of pregnant women in the study. Logistic regression was used to assess the relationship between BMI and PIH and expressed as relative risk with 95% confidence interval.

Ethical approval

Ethical approval for the study was given by the Ghana Health Service Ethical Review Committee and by the hospitals.

Results

Routine HMIS data availability and completeness

Key variables needed to assess the incidence of PIH were collected by all hospitals participating in the study. There was however variation in the completeness of the recordings. Age, parity, BP at ANC, weight and height records were 95–100% complete in the facility-based records. Completeness of data on BP at delivery, fundal height and gestational age at first visit varied across districts. Urine protein was not recorded in most of the hospitals. Details for data completeness are shown in Figures 1 and 2.

Background characteristics of the women in the study, variations in PIH and BMI

Table 1 summarises the demographic and obstetric characteristics of the women in the study by region of residence at the first antenatal care visit. The average age was about 27 years in both regions. There were

statistically significant differences between the women in the two regions on all the other variables.

There was a higher proportion of women with a parity of three or more in the Upper West (58%) than in Greater Accra region (42%), $P < 0.001$. The mean weight of the women in Greater Accra region was 63.1 kg (SD 12.7) and 58.1 kg (SD 8.2) in the Upper West region. There was a significant difference between the mean BMI of women in Upper West [22.4 kg/m^2 (SD 2.9)] and those in Greater Accra [24.7 kg/m^2 (SD 4.7)], $P < 0.001$. About 13.9% ($n = 212$) of women in Greater Accra were obese compared to 2.2% ($n = 24$) in the Upper West region ($P < 0.001$). Women who were overweight comprised 12.8% and 26.6% of ANC attendants in the Upper West and Greater Accra regions, respectively.

Both the mean SBP and DBP at the first antenatal visit were slightly higher for women in Greater Accra region than in Upper West region. Women in Greater Accra had a higher gestational age at the time of first antenatal care visit compared with women in the Upper West region.

After adjusting for the effect of gestational age, there were still significant differences between BMI, SBP and DBP respectively of women in the Upper West and Greater Accra regions ($P < 0.001$), and between the districts in each region ($P < 0.001$). The incidence of PIH among ANC attendants in the Upper West region ranged from 0.65% in Wa West to 6.5% in Nandom, with a
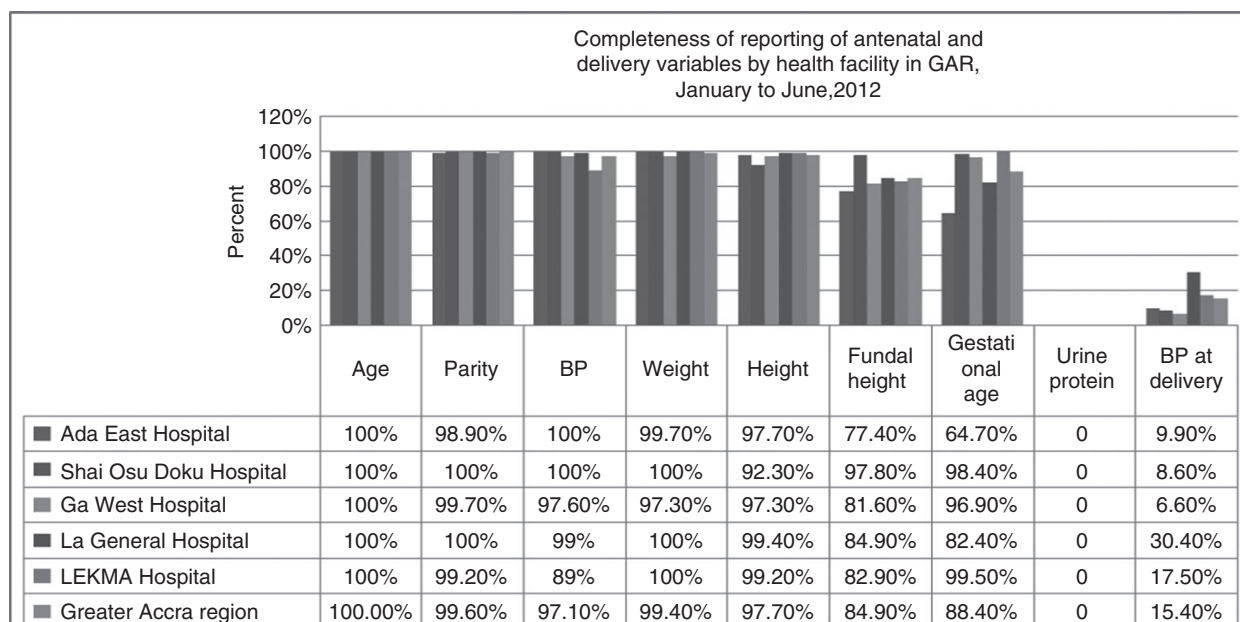

	Age	Parity	BP	Weight	Height	Fundal height	Gestational age	Urine protein	BP at delivery
■ Ada East Hospital	100%	98.90%	100%	99.70%	97.70%	77.40%	64.70%	0	9.90%
■ Shai Osu Doku Hospital	100%	100%	100%	100%	92.30%	97.80%	98.40%	0	8.60%
■ Ga West Hospital	100%	99.70%	97.60%	97.30%	97.30%	81.60%	96.90%	0	6.60%
■ La General Hospital	100%	100%	99%	100%	99.40%	84.90%	82.40%	0	30.40%
■ LEKMA Hospital	100%	99.20%	89%	100%	99.20%	82.90%	99.50%	0	17.50%
■ Greater Accra region	100.00%	99.60%	97.10%	99.40%	97.70%	84.90%	88.40%	0	15.40%

Figure 1 Completeness of reporting of antenatal and delivery variables by health facility in Greater Accra region, January to June, 2012.

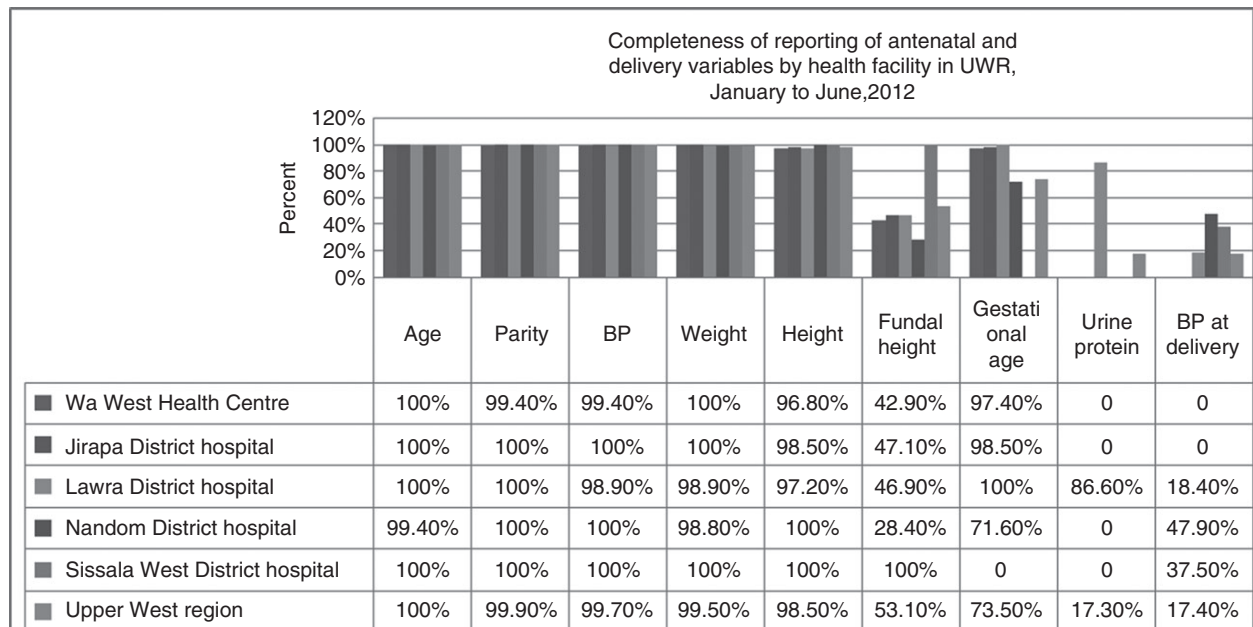**Figure 2** Completeness of reporting of antenatal and delivery variables by health facility in Upper West region, January to June, 2012.

Table 1 Demographic and obstetric characteristics of 2682 pregnant women by region of residence in Ghana at the first antenatal care visit

Variable [mean (SD)]	Greater Accra region n = 1578	Upper West region n = 1104	*P*-value
Mean age (years)	27.2 (5.8)	27.3 (6.3)	0.608
Gestational age (weeks)	13.9 (4.4)	11.7 (6.8)	<0.001
Mean height (cm)	159.7 (6.4)	160.9 (6.3)	<0.001
Mean weight (kg)	63.1 (12.7)	58.1 (8.2)	<0.001
Mean BMI (kg/m^2)	24.7 (4.7)	22.4 (2.9)	<0.001
Systolic BP (mmHg)	107.6 (11)	102.7 (9.7)	<0.001
Diastolic BP (mmHg)	64.5 (9)	62.9 (8.1)	<0.001
Parity			
0 (%)	491 (60.8)	317 (39.2)	<0.001
1–2 (%)	804 (66.1)	412 (33.9)	
≥3 (%)	275 (42.0)	374 (58.0)	
BMI category			
Overweight (25.0–29.9 kg/m^2) (%)	406 (26.6)	139 (12.8)	<0.001
Obese (≥30 kg/m^2) (%)	212 (13.9)	24 (2.2)	

regional mean of 3.2%. The incidence in Greater Accra region ranged from 4.3% in Ada East to 9.0% in La Dadekotopon with a regional mean of 6.1% (Table 2). The difference in the incidence of PIH between Greater Accra region and Upper West region was statistically significant ($P < 0.001$) as was the incidence of PIH between all the districts. Because of the incompleteness of data on BP at delivery, incidence of PIH manifesting for the first time at delivery could not be estimated and therefore also overall incidence of PIH – both occurring during pregnancy and at delivery could not be estimated.

Table 3 shows that obese women were at nearly double risk of developing PIH as normal weight women (OR = 1.85, 95% CI 1.00–3.43, $P = 0.05$). Overweight was not associated with increased risk of PIH (OR = 1.41, 95% CI 0.78–2.54, $P = 0.25$).

Discussion

The findings confirm our hypothesis that there are variations in the incidence of PIH between rural and urban areas of Ghana and that some of the variation may be associated with variation in risk factors for hypertension in general such as obesity. Significant differences in mean SBP and DBP of women in the two regions were observed, with average BP being higher in the urbanised Greater Accra region compared with the Upper West region.

The higher percentage of obese women in Greater Accra corresponded with a higher incidence of PIH in Greater Accra. Urbanisation is among the population changes that have been documented to contribute to the

Table 2 Incidence of pregnancy-induced hypertension across districts in the Upper West and Greater Accra regions of Ghana

Region	District*	Type of district	Rate of PIH (%)	95% Confidence Interval
Upper West	–	–	3.2	3.19–3.21
	Lawra	Rural	4.1	4.07–4.13
	Jirapa	Rural	0.97	0.96–0.98
	Wa West	Rural	0.65	0.64–0.66
	Nandom	Rural	6.5	6.46–6.54
	Sissala West	Rural	5.9	5.87–5.93
Greater Accra	–	–	6.1	6.09–6.11
	Ledzokuku Krowor	Urban	5.6	5.58–5.63
	La Dadekotopon	Urban	9.0	8.96–9.04
	Ada East	Rural	4.3	4.28–4.32
	Ga West	Mostly urban with rural areas	5.8	5.77–5.83
	Shai Osu Doku	Mostly rural but urbanising	6.6	6.57–6.63

*Source: GHANADISTRICTS.com accessed at www.ghanadistricts.com/districts on 20 December 2014.

Table 3 Association between body mass index (BMI) category and pregnancy-induced hypertension in 2682 women in Ghana

BMI category	Crude odds ratio (95% CI)	*P*-value
Normal weight (reference)	–	–
Underweight(<18.5 kg/m^2)	2.65 (1.38–5.08)	0.003
Overweight (25.0 kg/m^2–29.9 kg/m^2)	1.41 (0.78–2.54)	0.25
Obese (≥30 kg/m^2)	1.85 (1.00–3.43)	0.05

Table 4 Antenatal coverage by socio-demographic variables, Ghana Demographic and Health Survey 2003, 2008 and 2014

Variable	GDHS 2003 [ANC coverage (%)]	GDHS 2008 [ANC coverage (%)]	GDHS 2014 [ANC coverage (%)]
Region			
Upper West	90.9	95.7	98.3
Greater Accra	96.3	97.6	98.5
Residence			
Rural	88.6	93.9	96.0
Urban	97.9	97.8	98.8
Education level			
No education	86.1	93.5	94.1
Primary	92.6	93.5	95.9
Middle/JHS	96.9	97.6	99.2
Secondary[+]	100	98.9	99.9
Wealth quintile			
Lowest	83.3	92.5	94.0
Second	91.3	93.2	95.6
Middle	94.7	96.1	98.2
Fourth	95.3	97.7	99.4
Highest	98.2	99.1	99.7
Mothers age at birth(years)			
<20	93.8	97.3	97.8
20–34	92.7	95.5	97.6
35–49	88.6	94.3	96.3

+ secondary school education or higher.

development of overweight and obesity in LMICs. Urbanisation is known to be associated with lifestyle changes such as diet and decreased levels of physical activity that put people at increased risk of overweight and obesity [15–19]. In 2013, the prevalence of overweight and obesity among women in West Africa ranged from 12.4% in Chad to 55.7% in Mauritania. Ghana registered a prevalence of overweight among women of 38.4% and of obesity of 14.0% [18]. Higher obesity rates among women (up to 37.1%) have been documented in other studies in the urban Greater Accra region [20–22]. Apart from the mother, the foetus is also put at risk by maternal obesity, since maternal obesity is a known risk factor for adverse pregnancy outcomes [22–24].

Although data on local area variations in PIH incidence in sub-Saharan Africa or even between countries are scarce, data from other parts of the world suggest that it is an area of work that should be further explored in sub-Saharan Africa. Kaaja *et al.* [25] documented regional differences in the prevalence of pre-eclampsia in Finland. The Northern, Eastern and Southern parts of Finland had rates of 13.9%, 11.1% and 7.9% respectively. These regional differences remained significant after adjustment for several maternal factors such as age at first birth, current age, parity, BMI, diabetes, hypertension, coronary artery disease and mothers' myocardial infarction. Differences in pre-eclampsia rates were attributed to the risk factors of coronary artery disease among women in Finland.

The incompleteness of critical HMIS data such as BP at delivery limits the strength of the study and therefore our ability to be conclusive beyond doubt from the routine HMIS. Several of the gaps in the HMIS data availability could be attributed to the design of the antenatal and delivery registers, which have not made provision for these variables.

There were however a few other reasons for data incompleteness. Although staff were aware of existing protocol requirements, routine dipstick test for urine protein was often not done for pregnant women in the Upper West region because of stock out and non-availability of test kits. In the Greater Accra region routine testing of urine protein was done by the midwives at the ANC. Here too, one clinic reported occasional stock out of urine dipsticks. When this happened, pregnant women were asked to test their urine at private laboratories. In both regions the urine protein results were not recorded in the antenatal register again because it is not one of the variables in the register. Where the tests had been done at the hospital's laboratory it was sometimes possible to extract the result from the laboratory register. Yet even this had limitations as most of the laboratories did not have good records of the tests done. In instances in the Greater Accra region where the test was done at private laboratories, the option to confirm from the laboratory register was not available.

There were several reasons for the low percentage of fundal height recording even though that variable was in the register. In some clinics the fundal height was simply not recorded in the antenatal register. In other clinics the foetal heart rate was recorded rather than fundal height although the register had a footnote explaining the abbreviation 'fht' as fundal height.

Not all health facilities recorded the BP of the women at delivery in the delivery/maternity register because there is no column in the form for it. It was however recorded on the delivery sheets and in the nurses' notes. Accessing these documents was difficult because in some facilities the delivery sheets could not be traced.

These challenges can be addressed by changing national level requirements, recognising the importance of PIH in maternal outcomes. Addressing the gaps in the quality of the routine HMIS is likely to be an effective approach to ensure the needed routine monitoring as well as producing the evidence base related to local area variations in PIH incidence. In the study setting the interventions that need to be put in place to enable the use of routine HMIS data for such purposes are fairly simple and inexpensive and likely to be more cost effective than the use of special surveys. Interventions such as expanding the range of variables that are captured in the antenatal and delivery registers can make a major difference in the quality of the evidence available to inform decision making.

Addressing stock-outs and non-availability of urine protein testing strips is also a step that can make a difference not only to data quality but also to the health and outcome of pregnant women and newborns. The policy of allowing pregnant women to take their maternal health record books home was to ensure continuity of care in a setting in which women sometimes move from one clinic to another in the course of a pregnancy; and also where patient records storage is poor in facilities. Given that this situation has not changed, key information in the book should be extracted and kept in routine HMIS records of the clinic.

This study found statistically significant variations of PIH between districts and between the two regions. Maternal health policies and programmes should pay more attention in collecting evidence on local variations in maternal health conditions and take account of these local variations in the planning and delivery of health services.

Using a retrospective record review, the study was limited by the information obtained and recorded in the ANC and delivery registers. Hence detailed risk factor information such as family history of hypertensive disorders in pregnancy, chronic hypertension, diabetes, twin pregnancies, and personal lifestyle conditions such as smoking, dietary habits and physical activity could not be ascertained.

Our data collection was health facility- rather than community-based. However, it is reasonable to assume that the women in the study are representative of women in the community because the Ghana Demographic and Health Surveys (Table 4) showed that more than 95% of Ghanaian women attend antenatal care [8, 9].

Conclusion

There are significant variations in the incidence of PIH across districts in Ghana. More attention needs to be given to mapping and understanding local area variations in PIH within countries as well as between countries in sub-Saharan Africa. Possible relationships with urbanisation and lifestyle changes that promote obesity should be investigated in detail to provide information to inform maternal and newborn health policy and programme decisions. This can be done with HMIS data, but interventions need to be put in place to improve the data completeness. Attention also needs to be paid to quality of antenatal and delivery care inputs such as preventing stock out of reagents to test for urine protein. Despite high antenatal care coverage in the study setting (over 95%) and high skilled attendance at delivery, the quality of the service received can limit the impact on outcomes if these issues are not addressed.

Acknowledgements

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