# *Maternal and Perinatal Outcomes in Patients Admitted With Hypertensive Disorders of Pregnancy in Sub-Saharan African Tertiary Hospitals: A Systematic Review*

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## ABSTRACT

**Background:** Hypertensive diseases in pregnancy (HDP) are a combination of syndromes which include pre-existing hypertension or gestational hypertension, chronic hypertension, pre-eclampsia, and eclampsia, and are leading causes of maternal and neonatal morbidity and mortality. Therefore, this systematic review was set out to identify maternal and neonatal outcomes among women with HDP in tertiary hospitals in sub-Saharan African countries.

**Method:** A literature search was conducted of free articles written in English and published in sub-Saharan Africa between January 2012 to June 2022. The search was managed by Endnote X9 and documented in Microsoft Word 2016.

**Results:** For maternal outcomes identified outcomes were hemolysis elevated enzymes and low platelets count (HELLP), admission to the intensive care unit, and maternal mortality. Neonatal outcomes include stillbirth, low birth weight, pre-term birth, perinatal mortality, neonatal mortality, small for gestational age, low Apgar score, admission to neonatal intensive care unit, and post-partum haemorrhage. Almost half of all studies reviewed were conducted in Ethiopia 9(45%).

**Conclusion:** The common maternal outcomes reported were HEELP and mortality while neonatal outcomes are stillbirth, low birth weight, pre-term birth, perinatal mortality, and neonatal mortality. Heighten and persistent screening for risk factors for HDP should be encouraged to reduce the magnitude of adverse maternal and neonatal outcomes.
**Keywords:** Hypertensive Diseases of Pregnancy, Maternal and Neonatal Outcomes, Sub-Saharan Africa.

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## Background

Hypertensive disorders in pregnancy (HDP) are a combination of syndromes which may include pre-existing hypertension or gestational hypertension, chronic hypertension, pre-eclampsia, and eclampsia. Globally, it is estimated that HDP is responsible for over 70, 000 maternal mortalities with approximately one woman dying every 11 minutes (Magee et al., 2016). Globally, HDP is reported to be responsible for about 16% of annual stillbirth and accounts for 10% of all pregnancy complications with about one in every four perinatal deaths. Developing countries are disproportionately affected with more than 99% of the cases global cases (Duley, 2009), especially in sub-Saharan African countries.

There are a number of factors that are implicated in HDP-associated mortality such as lack or inadequate antenatal care, lack of proper screening of pre-eclampsia and eclampsia, inadequate skilled manpower to detect and manage women with HDP, low awareness of HDP,

and poor referral system from lower to higher levels of the health system that can manage and avoid mortality (Warren et al., 2015).

According to the United Kingdom's National Institute for Clinical Excellence (NICE) guidelines, one critical measure is regular assessment of blood pressure days following delivery especially seven days post-delivery. Also, it is highly recommended that for women with gestational hypertension, regular blood pressure check-ups should be up to six weeks after delivery accompanied by counselling regarding the potential future cumulative risk of cardiovascular attack with increasing pregnancy (NICE, 2013). Furthermore, NICE recommends cessation of methyldopa within 48 hours post-delivery to reduce the risk of depression. Moreover, reports suggest that women with HDP who are not on treatment during pregnancy close to half of them may need treatment after delivery due to the possibility of eclampsia and therefore, regular monitoring of blood pressure is important.

Reports suggest that a quarter of the women with HDP are likely to develop end-organ function especially those with severe conditions. This is common during puerperium mostly two months post-delivery (Deruelle et al., 2006). In early pregnancy, usually before 24 weeks, pre-eclampsia may be a risk factor for chronic hypertension sometimes even renal disease as well as venous thromboembolism. Other consequences of pre-eclampsia include but are not limited to cardiovascular impairment, stroke, and ischemic heart disease and it is advisable that babies born to women with HDP should be monitored for a considerable period due to potential risk (NICE, 2011).

At present, there a few studies that have synthesized evidence of maternal and neonatal outcomes among women with hypertensive disease in pregnancy. This review is aimed at addressing this gap.

## Literature Review

### Maternal and neonatal outcomes in HDP: A global public health issue

Hypertensive Disorders of Pregnancy are chief complications of pregnancy that are associated with increased risk of maternal and neonatal morbidity and mortality (Waterstone et al., 2001; Sibai, 2002). Globally, it is estimated that one-tenth of pregnant women are affected and in resource-poor settings, more than 10% of maternal mortality is associated with HDP (WHO 1988; Mackay et al., 1997; Bergstrom, 2001). Although the definite cause may be debatable, evidence suggests that pre-eclampsia as well as its advanced form, eclampsia which are multisystem disorders which are partly due to elevated blood pressure and the presence of proteins in urine (proteinuria) predisposes close to 10% of pregnancies (WHO, 1988, Duley, 2001). Eclampsia occurs in about 1 in 2000 deliveries in industrialized countries but almost 20 times higher in developing countries especially in settings with no capacity or urgent detection of women at risk. About 99% of the 600,000 global pregnant-associated deaths that occur every year are from developing countries of which sub-Saharan Africa has a larger share (WHO, 1995). Eclampsia is associated with most deaths in settings where maternal mortality is high while pre-eclampsia is low (WHO, 1994; 1995).

### Causes of HDP

The cause of HDP remains unknown but extant literature points to several risk factors. HDP is associated with lengthy inter-pregnancy interval (Basso et al., 2001) primigravidae especially in young women in the presence of pre-eclampsia, first pregnancy, age above 35 years, multiple pregnancy, presence of hypertension and diabetes (Lloyd and Lewiss, 1999), obesity and family history (Dawson et al., 2002). A study showed that almost one-third (31%) of women with HDP were primigravidae and close to half (48%) were grandmultipara (Mohamed et al., 1998). Another study reported hypertensive patients were 42.9% primigravidae, more than a quarter (27.3%) were below 20 years and less than one-fifth (18.3%) were over the age of 35 years (Buga et al., 1999). A few studies have documented the association of lengthy inter-pregnancy intervals with increased

odds of pre-eclampsia in women with no prior history of HDP and Primigravida is three times more likely to experience pre-eclampsia (Verwoerd et al., 2002). Another study revealed more empirical evidence about the association of lengthy pregnancy intervals and multiple pregnancies with increased risk of pre-eclampsia (Dawson et al., 2002). Preeclampsia is one of the strong risk factors for HDP.

**Management of Hypertensive Disorders of Pregnancy**

Studies have demonstrated that the best option to manage HDP is the delivery of the baby. However, the option of clinical management is highly dependent on the clinical staging of HDP. HDP is associated with high morbidity and mortality, especially in settings where optimal obstetric care is a challenge, lack of consumables and skilled health workers, and delay in the detection of the early danger signs (Lloyd and Lewis, 1999; Lydakis et al., 2001). WHO recommends the use of magnesium sulfate in pre-eclampsia to avoid progression to eclampsia but in cases where eclampsia has occurred either antihypertensive with anticonvulsant or magnesium sulfate is recommended (WHO, 2013).

**Maternal and neonatal outcomes in HDP: sub-Saharan Africa**

HDP are disproportionately higher in developing countries, especially in sub-Saharan Africa. HDP is associated with maternal and neonatal mortality. Globally, significant adverse maternal and neonatal outcomes occur in sub-Saharan Africa (Armstrong et al., 2014; Chuwa et al., 2017). In countries where adverse outcomes such as mortality are highest, about 1 in 10 babies do not contribute to neonatal mortality rate (Chuwa et al., 2017). There are a number of factors that are associated with adverse outcomes such as a lack of skilled healthcare workers, suboptimal obstetric facilities and prenatal care, and cultural beliefs that lead to distrust of the healthcare system (Zupan et al., 2005). Maternal adverse outcomes include HELLP syndrome, admission to the intensive care unit, and mortality. Neonatal outcomes include stillbirth, pre-term birth, low birth weight, low Apgar score, admission to neonatal intensive care unit, small for gestational age and mortality Lugobe et al., 2020; Irene et al., 2021; Wondimu et al., 2018; Seyom et al., 2015).

**Association between maternal and neonatal adverse outcomes and HDP**

This review addresses associations of maternal and neonatal outcomes in sub-Saharan Africa, and the association that hypertensive disorders in pregnancy (HDP) have on adverse maternal and neonatal outcomes. Women with HDP such as pre-eclampsia and eclampsia are 5 times more likely to experience adverse maternal outcomes such as death and HELLP compared to their counterparts without HDP. Moreover, studies have documented the linkage between HDP and several complications but not limited to HELLP, pulmonary edema, abruption placenta, and renal failure. Some neonatal adverse outcomes include stillbirth, low birth weight, pre-term delivery, and intrauterine foetal death (WHO, 2011; Adu-Bonsafooh et al., 2014; Duley, 2009). Other factors associated with increased odds of adverse outcomes are poverty and lack of knowledge or awareness regarding the risk factors (Yucesoy et al., 2005; Schmiegelow et al., 2012).

After a review of the literature, it is clear that there is a higher burden of adverse maternal and neonatal outcomes in women with HDP in sub-Saharan Africa than in any other region of the world. A review is necessary to highlight key adverse maternal and neonatal outcomes in HDP. Although a number of studies have been conducted in sub-Saharan Africa, there is very little thesis or empirical evidence in the available literature on the region. This review examined maternal and neonatal outcomes in HDP in sub-Saharan Africa from 2012-2022. It is assumed that the data will provide information regarding the evidence generated in the past 10 years on maternal and neonatal outcomes in HPD.

## Methods

A literature search was conducted between 1 and 31st July 2022, to identify outcome studies for maternal and perinatal in women with hypertensive disease in pregnancy in sub-Saharan Africa. Web of Science, PubMed, Google Scholar, and Scopus were searched, returning 235 results, and a total of 54 total unique results in each search (Figure 1).

Boolean search terms were used to identify appropriate publications to the topic and met the following criteria:

i. Published between 1st January 2012 and 30th June 2022.
ii. Reported maternal or perinatal findings.
iii. Written in English.
iv. Publication from sub-Saharan Africa

## Search strategy

All relevant articles were downloaded into an EndNote library and were used to review publications. Articles were sorted by using three categories and were labeled as "Yes," "No," or "Maybe," after screening of article abstracts. Dissertations, theses, conference abstracts, and book chapters were excluded Why? Further review of articles labelled "Yes" and "Maybe" to assess whether articles met the inclusion criteria. Further, articles were assessed for sample size, power, and study design. The following search terms were used: (hypertensive diseases in pregnancy) AND (maternal OR neonatal outcomes) AND (sub-Saharan African). The results of the search were then filtered to remove any duplicates and non-English results. All studies that were categorized as non-human that came up were removed. Further, studies that remain were assessed using the inclusion criteria. Additionally, assessment was conducted by screening their titles and abstracts for relevance to the research question.

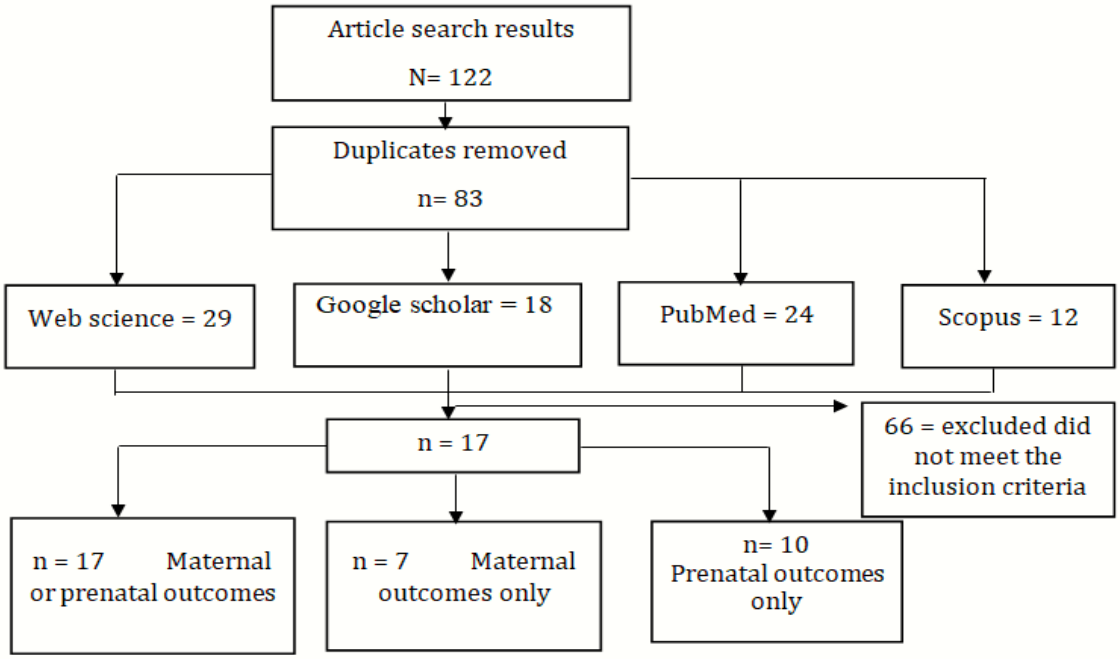


**Figure 1: PRISMA Flow diagram for the eligible studies included in the analysis.**

Out of 122 from the initial search, 39 were duplicates from other databases and were removed. Further, 66 were excluded because they were not in English and were not from sub-Saharan Africa. On Maternal and perinatal outcomes they were 17 articles that reported both

maternal and perinatal outcomes, 7 articles on maternal outcomes reported maternal outcomes only and 10 articles on perinatal outcomes reported perinatal outcomes only.

**Data extraction**

All articles that were not relevant and did not describe maternal and neonatal outcomes of HDP and were not relevant to the objective of this review were excluded. Some characteristics extracted included author name, year of publication, study design, country of publication, and target maternal and neonatal outcomes of HDP. Data obtained from the search sorted out and managed Endnote X9 software and later recorded in Microsoft Word.

**Data analysis**

Descriptive statistical analysis was conducted using the Excel 2016 version. Analysis was conducted related to authors, study design, country, year of publication and number of studies, percentages of countries represented in the review, percentage of each maternal and neonatal outcome of HDP.

**Ethical approval**

This was a review of the published articles and did not involve any human subject. Therefore, there was no need for ethical approval.

**Results**

**Characteristics of studies**

Seventeen of the identified studies assessed maternal and neonatal outcomes as shown in Table 1. In the final review 17 articles were included and the characteristics of the studies are shown in Table 1. These articles were published between January 2014 and June 2022. By year of publication 2022(n = 2), 2021 (n = 4), 2020 (n = 3), 2019 (n = 0), 2018 (n = 1), 2017 (n = 2), 2016 (n = 1), 2015 (n = 3) and 2014 (n = 1). Some studies have been conducted on maternal and neonatal outcomes among women with HDP across countries in sub-Saharan African countries with the sample size ranging from 53 to 1809.

**Number of studies**

Table 1 shows the number of studies that were reviews by year of publication. Majority 4 (23.5%) were published in the year 2021 and no studies published in 2019 were eligible for analysis.

| Year of Publication | Number of studies n (%) |
|---|---|
| 2022 | 2 (11.8) |
| 2021 | 4 (23.5) |
| 2020 | 3 (17.6) |
| 2019 | 0 (0) |
| 2018 | 1 (5.9) |
| 2017 | 2 (11.8) |
| 2016 | 1 (5.9) |
| 2015 | 3 (17.6) |
| 2014 | 1 (11.80) |
| **Total** | **17 (100)** |

**Table 1: Year of publication and number of studies.**

**Articles by countries**

Most of the articles reviewed were 6 (35.3%) from Ethiopia, 4 (23.5%) from Ghana, 1 (5.9%) from Botswana, 1(5.9%) from Rwanda, 1 (5.9%) from Uganda, 1(5.9%) from Benin, 1 (5%) from Kenya, 1 (5.9%) from Nigeria and 1 (5%). In terms of study designs used, the majority 9(47.1%) were cross-sectional, 7 (41.2%) respective cohort, and 1 (5.9%) case-series (Table 2).

| Author and year | Title | Study design and country | Neonatal outcomes reported |
|---|---|---|---|
| Hailu et al., 2022 | Prevalence and Determinants of Pregnancy Outcomes among Mothers with Hypertensive Disorders at Woliso Saint Luke Hospital, South-west Ethiopia | Cross-sectional, Ethiopia | Neonatal mortality, LBW |
| Onoh et al., 2022 | Obstetric outcome of pregnancies complicated by hypertensive disorders of pregnancy | Retrospective review, Nigeria | NICU, neonatal mortality |
| Irene et al., 2021 | Maternal and perinatal outcomes in women with eclampsia by mode of delivery at Riley mother baby hospital: a longitudinal case-series study | Case-series, Kenya | Neonatal mortality, LBW, NICU, stillbirth |
| Drechsel et al., 2021 | Maternal near-miss and mortality associated with hypertensive disorders of pregnancy remote from term: a multicenter observational study in Ghana | Cross-sectional, Ghana | PTB, stillbirth, neonatal mortality NICU |
| Jaleta et al., 2021 | Perinatal outcomes of women with hypertensive disorders of pregnancy in Jimma Medical Center, southwest Ethiopia: Retrospective cohort study | Retrospective cohort, Ethiopia | Stillbirth, low Apgar score, NICU, neonatal mortality |
| Jacques et al., 2021 | Factors Associated with Pregnancy Outcomes in Hypertensive Pregnant Women in a District Hospital in Benin | Cross-sectional, Benin | PTB, LBW, stillbirth, neonatal mortality |
| Lugobe et al., 2020 | Risks of adverse perinatal and maternal outcomes among women with hypertensive disorders of pregnancy in south-western Uganda | Prospective cohort, Uganda | Stillbirth, NICU neonatal mortality |
| Dassah et al., 2020 | Maternal and perinatal outcomes among women with hypertensive disorders in pregnancy in Kumasi, Ghana | Cross-sectional, Ghana | PTB, low Apgar score, LBW, NICU, neonatal morality |
| Uwizeyimana et al., 2020 | Neonatal Outcomes from Mothers with Hypertension Disorders of Pregnancy: A Retrospective Study at a Referral | Cross-sectional, Rwanda | LBW, NICU, neonatal mortality, PTB |

| | | | |
|---|---|---|---|
| | Hospital in Rwanda | | |
| Obsa et al., 2018 | Neonatal and Fetal Outcomes of Pregnant Mothers with Hypertensive Disorder of Pregnancy at Hospitals in Wolaita Zone, Southern Ethiopia | Cross-sectional, Ethiopia | Apgar score, LBW, stillbirth |
| Johnsosn et al., 2016 | Hypertensive disease in pregnancy in Botswana: Prevalence and impact on perinatal outcomes | Cross-sectional, Botswana | Stillbirth, PTB, neonatal mortality, SGA |
| Ngwenya et al., 2017 | Severe pre-eclampsia and eclampsia: incidence, complications, and perinatal outcomes at a low-resource setting, Mpilo Central Hospital, Zimbabwe | Cross-sectional, Zimbabwe | LBW, NICU, stillbirth, neonatal mortality |
| Adu-Bonsaffoh et al., 2017 | Perinatal outcomes of hypertensive disorders in pregnancy at a tertiary hospital in Ghana | Cross-sectional, Ghana | Low Apgar score, NICU, stillbirth, neonatal mortality LBW |
| Seyom et al., 2015 | Maternal and foetal outcome of pregnancy related hypertension in Mettu Karl Referral Hospital | Retrospective study, Ethiopia | Stillbirth, PTB, low Apgar score, neonatal mortality |
| Browne et al., 2015 | Perinatal outcomes after hypertensive disorders in pregnancy in a low resource setting | Cross-sectional, Ghana | PTB, LBW, neonatal mortality |
| Terefe et al., 2015 | Patterns of hypertensive disorders of pregnancy and associated factors at Debre Berhan referral hospital, north Shoa, Amhara region. | Cross-sectional, Ethiopia | PTB, neonatal mortality, LBW, low Apgar score |
| Endeshaw et al., 2014 | Perinatal Outcome in Women with Hypertensive Disorders of Pregnancy: A Retrospective Cohort Study | Retrospective cohort, Ethiopia | PTB, LBW |

**Table 2: Neonatal outcomes by authors.**

**Neonatal outcomes**

Neonatal outcomes were attested to by several articles. stillbirth was reported in 10 articles, low birth weight by 10, pre-term birth 9, neonatal mortality death by 10, and low Apgar score in 6 articles and 9 neonatal intensive care units (Table 2).

**Maternal outcomes**

From the 17 articles reviewed on maternal outcomes of HDP, 7 articles reported maternal

mortality, 4 admissions of mothers to the intensive care unit, 3 HELLP, and 1 post-partum haemorrhage (Table 3).

| Author and year | Title | Study design and country | Maternal outcomes reported |
|---|---|---|---|
| Hailu et al., 2022 | Prevalence and Determinants of Pregnancy Outcomes among Mothers with Hypertensive Disorders at Woliso Saint Luke Hospital, South-west Ethiopia | Cross-sectional, Ethiopia | Mortality |
| Onoh et a., 2022 | Obstetric outcome of pregnancies complicated by hypertensive disorders of pregnancy | Retrospective review, Nigeria | Maternal death, ICU admission |
| Irene et al., 2021 | Maternal and perinatal outcomes in women with eclampsia by mode of delivery at Riley mother baby hospital: a longitudinal case-series study | Case-series, Kenya | ICU admission, HELLP |
| Drechsel et al., 2021 | Maternal near-miss and mortality associated with hypertensive disorders of pregnancy remote from term: a multicenter observational study in Ghana | Cross-sectional, Ghana | Maternal death |
| Jaleta et al., 2021 | Perinatal outcomes of women with hypertensive disorders of pregnancy in Jimma Medical Center, southwest Ethiopia: Retrospective cohort study | Retrospective cohort | Not reported |
| Jacques et al., 2021 | Factors Associated with Pregnancy Outcomes in Hypertensive Pregnant Women in a District Hospital in Benin | Cross-sectional, Benin | Maternal death, PPH |
| Lugobe et al., 2020 | Risks of adverse perinatal and maternal outcomes among women with hypertensive disorders of pregnancy in south-western Uganda | Prospective cohort, Uganda | ICU admission, HELLP, no maternal death |
| Dassah et al., 2020 | Maternal and perinatal outcomes among women with hypertensive disorders in pregnancy in Kumasi, Ghana | Cross-sectional, Ghana | Maternal death, ICU admission |
| Uwizeyimana et al., 2020 | Neonatal Outcomes from Mothers with Hypertension Disorders of Pregnancy: A Retrospective Study at a Referral Hospital in Rwanda | Cross-sectional, Rwanda | Not reported |
| Obsa et al., 2018 | Neonatal and Fetal Outcomes of | Cross-sectional, | Not reported |

| | | | |
|---|---|---|---|
| | Pregnant Mothers with Hypertensive Disorder of Pregnancy at Hospitals in Wolaita Zone, Southern Ethiopia | Ethiopia | |
| Johnsosn et al., 2016 | Hypertensive disease in pregnancy in Botswana: Prevalence and impact on perinatal outcomes | Cross-sectional, Botswana | Not reported |
| Ngwenya et al., 2017 | Severe pre-eclampsia and eclampsia: incidence, complications, and perinatal outcomes at a low-resource setting, Mpilo Central Hospital, Zimbabwe | Cross-sectional, Zimbabwe | Not reported |
| Adu-Bonsaffoh et al., 2017 | Perinatal outcomes of hypertensive disorders in pregnancy at a tertiary hospital in Ghana | Cross-sectional, Ghana | Not reported |
| Seyom et al., 2015 | Maternal and foetal outcome of pregnancy related hypertension in Mettu Karl Referral Hospital | Retrospective study, Ethiopia | HELLP, maternal mortality |
| Browne et al., 2015 | Perinatal outcomes after hypertensive disorders in pregnancy in a low resource setting | Cross-sectional, Ghana | Not reported |
| Terefe et al., 2015 | Patterns of hypertensive disorders of pregnancy and associated factors at Debre Berhan Referral Hospital, North Shoa, Amhara region. | Cross-sectional, Ethiopia | Maternal mortality |
| Endeshaw et al., 2014 | Perinatal Outcome in Women with Hypertensive Disorders of Pregnancy: A Retrospective Cohort Study | Retrospective cohort, Ethiopia | Maternal death |

**Table 3: Maternal outcomes of HDP by author.**

## Discussion

### Discussion of main findings

This systematic review suggests that maternal and neonatal outcomes of HDP occur in sub-Saharan African countries and are still obstetric concerns, especially in countries such as Ethiopia and Ghana which have the highest number of published articles. Some of the most reported neonatal outcomes of HDP are stillbirth, low birth weight, pre-term births, low Apgar score, and admission to the neonatal intensive care unit. The last reported neonatal outcome reported is small for gestational age. For maternal outcomes, the common ones were HELLP syndrome and maternal mortality while the rare ones were admission to intensive care units and PPH.

There are many observational studies that have been published on maternal and neonatal outcomes of HDP, it appears most studies have reported more on neonatal than maternal outcomes.

Evidence indicates that babies born to women with HDP are more likely to experience adverse outcomes than their counterparts with HDP (Lugobe et al., 2020; Dassah et al., 2021; Onoh et al., 2022). For example, the literature indicates

that babies born to mothers with HDP have increased odds of low birth weight or premature (Terefe et al., 2015; Dassah et al., 2020). One plausible mechanism is that it is difficult for nutrients to pass through the placenta from the mother to the baby in mothers with HDP compared to their counterparts without HDP. Additionally, the effect is more pronounced with increasing severity of HDP. Low birth weight is associated with an increased risk of death, especially within the first year of life and later childhood cognitive developmental problems as well as various diseases in adulthood (Wilcox 2001). Also, significant literature suggests that low birth weight is associated with cardiovascular disease, chronic type 2 diabetes, and hypertension in adulthood (Halbreich 2005). Based on the literature reviewed, the results suggest urgent action to adequately control blood pressure for women throughout pregnancy irrespective of underlying pathological factors.

In this review, most studies reported both maternal and neonatal mortality which could be due to pre-eclampsia and eclampsia (Drechsel et al., 2021 Endeshae et al., 2014). Generally, there are two main etiologies of HDP which are pre-eclampsia and eclampsia, and can be distinguished by gestational age on onset. Early onset is considered when it starts before 34 weeks and late when it sets in on or after 34 weeks of gestational age. The distinction is key as there are differences in terms of maternal and neonatal outcomes, clinical presentation, and prognosis (Huppertz 2008, Gomathy et al., 2018). Early onset of pre-eclampsia may occur in one in every five pregnant women with pre-eclampsia and such women have increased odds of delivering babies with small for gestational age and foetal growth restriction (Madazi et al 2018, Sulistyowati et al 2017). About three-quarters of women with pre-eclampsia may experience late onset of pre-eclampsia which is associated with morbidity and mortality for both the baby and mother. World Health Organization suggests that women with early pre-eclampsia should be given 75 mg (low dose) of aspirin as prophylaxis as they are more likely to have higher risk compared to women with late pre-eclampsia (WHO, 2011). In sub-Saharan African countries, low-dose aspirin as prophylaxis should be heightened and persistent for women at risk of pre-eclampsia.

In this review, more than half of the studies reported on pre-term birth. Empirical evidence suggests that pre-term (< 37 weeks) is one major factor associated with morbidity, neonatal and under-five mortalities as well as other health complications later in life. Gestational age is a significant predictor of adverse neonatal outcomes. Studies have reported that pre-term babies born to mothers diagnosed with HDP are more likely to have adverse perinatal outcomes such as mortality compared to term babies (Endeshaw et al., 2015; Nkamba et al., 2019). Of the global magnitude of pre-term, sub-Saharan Africa is responsible for more than 60% of the global estimates (Every Preemie Scale 2018) and a significant proportion are among women with HDP.

This literature review was conducted in sub-Saharan African countries where the problem of pre-term is higher than any other region in the world and this calls for urgent attention to begin to reverse this magnitude. There are several plausible reasons for the high magnitude which include lack of adequate skilled health workers to promptly detect women at risk of HDP, lack of ANC attendance, long distances to health facilities that offer comprehensive obstetric care, and poverty (Hailu et al., 2022). Adequate ANC gives an opportunity window for prompt diagnosis and management of any complications that may arise due to HDP such as pre-term.

Global evidence from 184 countries showed that stillbirth ranged from 5 to 18% and countries from sub-Saharan Africa countries dominated the upper range (WHO 2019, Blencowe et al 2012). Despite several decades of global consented efforts to reduce stillbirth, it is still a public health problem, and sub-Saharan Africa is disproportionately affected. Several major

contributors to stillbirth rates in sub-Saharan African countries include Ethiopia (Terefe et al., 2020), Ghana (Adu-Bonsaffoh et al., 2017), Zimbabwe (Ngwenya et al., 2017), and Nigeria (Onoh et al., 2022) partly due a number of studies conducted in these countries which have highlighted the problem. Some studies showed that stillbirth rate ranges from 28 to 38 per 1,000 births. Studies have suggested that several factors are associated with stillbirth including young maternal age, lack of maternal education, poverty, primiparity, and vaginal haemorrhage (Uwizeyimana et al., 2020, Jacques et al., 2020; Jelata et al., 2020). While this review suggests that many studies that have reported stillbirth other studies on neonatal outcomes among women with HDP lack data on stillbirths. High stillbirth in sub-Saharan Africa may give raise to questions about the quality of ANC and intrapartum care. For example, some previous studies have indicated that suboptimal quality of care and health inequalities between women with HDP in rural and urban areas have been reported to have different maternal and neonatal outcomes such as stillbirth. Women with HDP living in rural areas are reported to be more likely to have adverse outcomes compared with their urban counterparts (Poeran et al., 2011).

It is recommended that in women with HDP, blood pressure should be measured for the first 3 days and once more before day 5 after delivery (NICE 2011). Most studies reviewed did not indicate whether this recommendation was followed and could be due lack of knowledge or documentation of BP measurement. Assessment of protein in urine (proteinuria) is key in the diagnosis of pre-eclampsia and eclampsia in pregnant women together with blood pressure which are major risk factors for HDP. Although these are supposed to be routine tests among pregnant women during ANC visits, there are challenges in sub-Saharan Africa. For instance, reports suggest that women who are tested for proteinuria were 10% in Mozambique (Betran et al., 2018), 32% in Ethiopia (Ejigu et al., 2013) 23% in Zambia (Kyei et al., 2012), 27% in Congo DR (Nkamba et al., 2019), 31% in Rwanda, 29% in Madagascar (29%), 40% in Tanzania (40%), 59% in Kenya and 66% in Ethiopia (Rawlins et al., 2018). These proportions might suggest unmet needs for comprehensive ANC care which may partly explain adverse maternal and neonatal outcomes.

Studies have suggested that urine tests are available in most health facilities in sub-Saharan African countries but there is low utilization of testing for proteinuria. In this regard, questions are raised about whether there is inconsistence in the national guidelines or lack of knowledge by the health workers to screen for HDP (Rawlins et al., 2019; Nkamba et al., 2017) and this implies a loss of opportunity to prevent HDP. More heightened and persistent efforts should be towards screening for HDP in primary health care facilities which are common in most sub-Saharan African countries as the first contact health facilities.

Some of the maternal and neonatal outcomes in sub-Saharan Africa could be preventable. For example, WHO recommends magnesium sulfate as an effective drug for the treatment of pre-eclampsia and eclampsia which are core causes of HDP which are widely used in developed countries. However, in sub-Saharan Africa diazepam and phenytoin are widely used which are less effective and the lack of guidelines to re-enforce mandatory use of magnesium sulfate predisposes women to higher risks of adverse maternal and neonatal outcomes (Khosla et al., 2006). Lapses in the quality of care such as the provision of anti-hypertensive drugs during the postnatal period among women with HDPs could predispose them to life-threatening adverse conditions such as cardiovascular conditions.

In this review, a few studies reported on maternal hemolysis elevated liver enzymes and low platelets (HELLP) syndrome. HELLP is defined as an atypical type of severe pre-eclampsia, and is characterized by hemolysis, elevated liver function test, and low platelet count (ACOG, 1996). The incidence of HELLP is more than twice higher

during the antenatal than post-natal period and it is associated with severe pre-eclampsia. HELLP among women HDP is common and associated with increased odds of maternal and perinatal mortality (Martin et al., 1996; Sibai, 2004). In resource-poor settings such as those commonly found in sub-Saharan Africa, share significant magnitude of HELLP with adverse outcomes among women with HDP compared to other regions. For example, in developed countries women with HELLP the complications may be around 2% with less than 1% mortality while in sub-Saharan Africa mortality is much higher. For example, in Kenya, a study reported that 20.8% complete and 11.3% incomplete HELLP among women with HDP (Irene et al., 2021) while in Uganda, a study reported a prevalence of 7.8% (Lugobe et al., 2020). In most resource-poor settings where proper laboratory services are a challenge, the magnitude of HELLP may be underestimated (Lugobe et al., 2020). This calls for full laboratory services such as liver function tests and full blood count at all facilities that offer antenatal care services to detect organ dysfunction early to institute prompt management.

One postulated explanation of how HELLP occurs is that it is associated with pre-eclampsia which could be explained by defective placental vascular transformation, especially during the second trimester which involves trophoblastic invasion into the deciduas culminating into insufficient placental perfusion. Placental perfusion results in reduced oxygen in the placenta leading to the discharge of numerous placental elements (Fisher, 2015). For example, soluble vascular endothelial growth factor receptor-1 (sVEGFR-1), placental growth factor (PGF), and vascular endothelial growth factor (VEGF) resulted in both placental dysfunction and endothelial cell stopping from non-binding to endothelial cell receptors. The final outcome results in elevated platelet activation and accumulation resulting in low platelet count, hepatic injury, and haemolysis (Fisher, 2015).

This review may be limited by heterogeneous definitions of HDPs and this impedes data comparisons across countries, however, even studies using a comparable definition of HDP seem to report variable magnitude of maternal and neonatal outcomes. One possible explanation could be due to the difference in effective screening and monitoring of women with HDP which could lead to higher detection rates.

**Conclusion**

In summary, it seems there are many studies that have identified maternal and neonatal outcomes among women with HDP. HDP indicates a medical condition that needs an urgent response, handled with special care, and appropriate knowledge by healthcare workers to reduce both maternal and neonatal mortality. Counselling, education, and awareness by both healthcare workers and pregnant women with HDP have the potential to preserve the lives of mothers and neonates. More relentless efforts should be advocated to continue highlighting the magnitude of maternal and neonatal outcomes in sub-Saharan Africa among women with HDP to improve awareness as part of checking the quality of obstetric care. HDP contributes to adverse maternal and neonatal outcomes. Comprehensive interventions to improve maternal and neonatal outcomes among mothers with HDP should be pursued in addition to adequate provision of ANC and obstetric care in sub-Saharan African regions with high rates of HDP. Additionally, some countries need more empirical evidence on the magnitude of maternal and neonatal outcomes among women with HDP. It is possible that countries that did not report any studies do not necessarily mean that the magnitude of the problem is low but maybe awareness and capacity to conduct such studies should be enhanced. It is recommended that studies should balance between maternal and neonatal outcomes as it was observed that most studies focused more on maternal than neonatal outcomes.

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