Association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women in Southern Africa

BY

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DECLARATION

I, Lesley Samantha Mhlanga (2413899), declare that this research report is my original and unaided work. I have followed the American Psychological Association referencing conventions to acknowledge the thoughts and ideas of other authors. It is being submitted to the Faculty of Humanities and School of Social Sciences, University of Witwatersrand, in partial fulfillment of the Master of Arts in Demography and Population Studies. To the best of my knowledge, this report has not been submitted in part or full for any other degree or examination at this or any other institution.

Signature: Date: 14 March 2024

DEDICATION

This work is dedicated to the Lord Almighty, all young African girls who aspire to do hard things, my future offspring, and my family for supporting me throughout this tedious journey.

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Thank the Lord God Almighty for making this academic journey successful. If it were not for His grace that has been sufficient for me, I would not have made it this far. It has been a journey filled with moments of self-doubt and long stints of fatigue, but through it all, God has remained faithful and fulfilled His word over my life.

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List of Abbreviations

ANC	Antenatal Care
BANC	Basic Antenatal Care
BMI	Body Mass Index
BP	Blood Pressure
DASH	Dietary Approaches to Stop Hypertension
dBP	Diastolic blood pressure
DHS	Demographic and Health Survey
FAMMD	Framework for Analyzing Maternal Mortality Determinants
HDP	Hypertensive Disorders of Pregnancy
IR	Individuals recode
ISSHP	International Society for the Study of Hypertension in Pregnancy
LMICs	Low-and middle-income countries
NCDs	Non-communicable diseases
NMHSS	Namibia Ministry of Health and Social Services
NPRI	Non-pregnancy related illness
PR	Person Recodes
SACs	Southern African countries
sBP	systolic blood pressure
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNFPA	United Nations Population Fund
WHO	World Health Organization

ABSTRACT

Background:

Hypertensive Disorders of Pregnancy (HDP) are among the primary causes of maternal and newborn infant deaths and morbidity globally. It affects between 5 to 10% of pregnancies, and 14% of pregnant women worldwide die due to HDP related complications. There are several known HDP risk factors, both those that can be changed and those that cannot. However, there are conflicting reports on the impacts of dietary and behavioral habits on HDP. As a result, the role of perinatal behaviors on HDP outcomes remains unclear.

Objective:

This study aims to determine the prevalence of HDP and examine the association between perinatal behaviors and HDP among pregnant and postpartum women in three Southern African countries (South Africa, Namibia, and Lesotho).

Methodology:

This investigation employed a cross-sectional study design utilizing secondary data from the most recent population-based DHS programs for South Africa (2016), Lesotho (2014), and Namibia (2013). The study population comprised 1273 pregnant and postpartum women with complete blood pressure measurements. Chi-square statistical tests were conducted to describe the prevalence of HDP. Adjusted and unadjusted binary logistic regression analyses assessed the relationship between perinatal behaviors and HDP. Stata statistical software (v.14) was used for data management and analysis.

Results:

Of the 1273 participants enrolled in the study, about 221 (17.36%) HDP cases were identified, while the majority, 1052 (82.6%), had no HDP in all three Southern African countries. The prevalence of HDP was higher in Namibia (23.78%) and South Africa (23.75%) than Lesotho (11.54%). After accounting for confounders, only iron supplement intake, was confirmed to be a significant predictor of HDP. Iron supplement intake increased the odds of HDP by three fold among study participants (AOR: 2.99; CI: 2.00 to 3.72; $p < 0.05$).

Conclusion

This study concluded that of the five main predictor variables analyzed in this study, routine iron supplementation was the only significant predictor of HDP among pregnant and postpartum women in these three Southern African countries. HDP prevalence was notably higher in these three countries compared to global and regional estimates, with Namibia and South Africa showing higher rates than Lesotho, despite their upper middle-income status.

Chapter 1: Introduction

1.1 Background:

Hypertensive Disorders of Pregnancy (HDP) is one of the primary reasons for poor pregnant and newborn health outcomes globally (Wang et al., 2021; World Health Organization, 2018). Despite the global disagreement and inconsistency in the classification, diagnoses, and management of HDP, HDP generally refers to a group of hypertension-related disorders in pregnancy diagnosed by a systolic blood pressure (sBP) $\geq$ 140 and diastolic blood pressure (dBP) $\geq$ 90 mm Hg (Brown et al., 2018; Singh et al., 2014). This study adopts the definition provided by the International Society of the Study of Hypertension in Pregnancy (ISSHP). It provides the following types of HDP categorized into two groups; 1. Hypertension that was diagnosed prior to or during the first twenty weeks of gestation, including persistent hypertension 2. Hypertension that manifests itself for the first time during or after pregnancy; this category includes gestational hypertension, preeclampsia, and transient gestational hypertension. (Brown et al., 2018).

Yearly, 5 to 10 % of pregnant women are affected by HDP, and an estimated 14% of pregnant women die due to HDP worldwide (Say et al., 2014; WHO, 2018). In absolute numbers, HDP affects up to 9 million women and is responsible for at least 70,000 fetuses and newborns and 500,000 mothers' deaths yearly (Brown et al., 2018; Meazaw et al., 2020a). Umesawa and Kobashi (2017) reported global prevalence rates of 8.2% (HDP), 4.4% (gestational hypertension), and 9.2% (preeclampsia). Of the four types of hypertensive pregnancy diseases that develop at or after pregnancy, pre-eclampsia, eclampsia, and gestational hypertension significantly cause maternal and child mortality and morbidity globally (Palacios & Pena-Rosas, 2010; Roberts et al., 2003; Say et al.,2014; WHO, 2021).

However, the lack of a worldwide agreement on the classification of HDP has resulted in inconsistencies in scholarship that reports on the different forms of HDP, making it difficult to compare and determine the prevalence of the various HDP types (Umesawa & Kobashi, 2017). For this study, HDP was measured as a single outcome except for preeclampsia which requires high BP readings accompanied by symptoms of proteinuria, convulsions, intractable headache, and repeated visual scotomata (Brown et al., 2018).

The global risk of HDP-related maternal mortality is around 1 in 1700 to 1 in 2100 (Abalos et al., 2013). Wang et al. (2021) reported that the global incidence of HDP remains alarmingly high, increasing by 10.92% between 1990 and 2019, from 16.8 million to 18.08 million.

Nonetheless, HDP-related mortality and morbidity vary substantially across regions. In Sub-Saharan Africa, 1 in 39 people is at risk for HDP, than 1 in 3800 in lower and middle income countries (Abalos et al., 2013). Recent estimates indicate that around 1 in 10 pregnancies in Sub-Saharan Africa (SSA) are impacted by HDP (Noubiap et al., 2019). Recently, South Asia (3.84 million) and Sub-Saharan Africa (10.67 million) reported the highest incidence of HDP (Wang et al., 2021). Overall, hemorrhage and HDP are reported as the major causes of maternal mortality in low-and-middle income countries (LMICs) (Khan et al., 2006; Gemechu et al., 2020). Hence, effective treatment, management, and prevention efforts are required since worsening HDP can result in a double problem of maternal and infant mortality and increase the chances for women of developing other diseases in future (Benschop et al., 2019; Lykke et al., 2009; Wang et al., 2013).

Modifiable and non-modifiable risk factors and predictors of HDP have been identified in several research conducted on SSA (Agbo et al., 2016; Meazaw et al., 2020a; 2020b). These included maternal body mass index, education status, anemia, maternal age, birth order, parity, history of HDP, and disease that were already there (Ayogu et al.,2020; Muti et al., 2015; Mwanri et al., 2015; Nathan et al., 2018; Suy et al., 2006; Owiredu et al., 2012). Also recognized as important in the study of HDP were perinatal behaviors factors.

Perinatal behaviors sums up the habits that women adopt during pregnancy and after giving birth namely, iron supplements intake, smoking, occupation types as a measure of physical activity, consumption of fruits and vegetables, Goodman (2019). Studies have indicated that perinatal behaviors either good or bad are associated with socioeconomic factors that include culture but most importantly poverty related factors (Drago et al., 2020, Duberstein, et al., 2021 Ban et al.,2012). Moreover, according to data from UN Women, 62.8% of women and girls in Sub-Saharan Africa are living in extreme poverty. It is crucial to understand and address these issues in order to provide solutions to the high prevalence of HDP among women and girls in African countries.

However, evidence of the preventative role of various maternal nutrition habits and smoking to HDP has varied among population groups and remained inconclusive, inconsistent and in some studies, no significant association has been reported (Meazaw et al., 2020a; Schoenaker et al., 2014). For instance, research conducted in the Netherlands, the United States, and Denmark did not find maternal adherence to healthy diet habits prescribed to the nonpregnant population protective against HDP (Arvizu et al., 2020; Fulay et al., 2018; Wiertsema et al., 2021). Notably, these studies noted that Dietary Approaches to Stop Hypertension (DASH) diet characterized by consuming fruits, vegetables, and low-fat dairy foods was not statistically significant in reducing the odds of HDP. In contrast, research in Tanzania and Zimbabwe has found a significant association between consuming diets rich in fruits and vegetables and HDP (Atkinson et al., 1998; Mwanri et al.,2015). Surprisingly, those who adhered to a food pattern rich in fruits and leafy green vegetables were at increased risk of developing HDP. This brings into question the role of dietary aspects in preventing HDP and the importance of developing practical dietary guidelines specific to pregnant and postpartum women in Southern Africa.

The provision of Standard Antenatal Care (SANC) is among the efforts to improve the treatment and care of HDP in LMICs. Implicit in implementing SANC is promoting healthy dietary patterns and focused attention to pregnant women presenting signs and symptoms of all forms of HDP at every level of care (WHO, 2016). While several scholars have examined the relationship between pregnant women diet behaviors, physical activity, tobacco use, and HDP in SSA, a few have been done in Southern Africa utilizing population-based samples. The objectives of this study were twofold: first to ascertain the levels of HDP and secondly: examine the association between perinatal behaviors, namely physical activity, smoking, and wide-ranging maternal nutrition habits, with the odds of HDP HDP among pregnant and postpartum women in Southern Africa.

1.2 Problem Statement:

Despite international and local efforts through Standard Antenatal Care (SAC) implementation and clinical management improvements, HDP mortality and morbidity continues to significantly impact pregnant women and their unborn children in Southern Africa. HDP mortality statistics for the three Southern African countries currently under scrutiny suggest a rise in pregnant women dying from HDP problems, thereby complicating national and global maternal mortality goals.

In South Africa, despite gains in lowering maternal mortality owing to a reduction in non-pregnancy-related illness (NPRI), maternal deaths attributable to HDP have increased and accounted for 15% of deaths between 2011-2013 (Saving Mothers Report, 2017). Maternal deaths complicated by HDP increased by 14% in 2017, contributing to 22% of avoidable maternal deaths (Businge et al., 2022; Moodley et al., 2016; Saving Mothers Report, 2017). From 2014 to 2016, 70% to 75% of maternal deaths were potentially preventable, aggravated by the inability to reduce HDP-related mortality (Moodley et al., 2019).

Similarly, Lesotho grapples with alarmingly high maternal mortality rates, where a substantial number of fatalities can be attributed to HDP (UNFPA, 2021). Specifically, a Maternal Death Review report of 2010, reported that 42.6 % of maternal deaths among young mothers were attributed to pregnancy-induced hypertension and hemorrhage in Lesotho (Ministry of Health, 2010). While in 2021, UNFPA reported that studies have reported that 24% of pregnant women in Lesotho die due to HDP related complications (UNFPA, 2021). In Namibia, preeclampsia stands as a primary contributor to maternal mortality, accounting for 10% of deaths among pregnant women and contributing to 60% of overall preventable maternal deaths, placing Namibia among the countries with the second-highest maternal mortality rates in the region (Namibia Ministry of Health and Social Services, 2014; NMHSS, 2017). Despite advancements in addressing NPRI, including mother-to-child HIV transmission, HDP remains a persistently significant cause of avoidable maternal mortality in all three countries, warranting in-depth investigation.

While the connection between HDP and maternal mortality is well established, there remains inconclusive evidence regarding the factors that give rise to HDP in the first place. Previous research has identified both modifiable and non-modifiable risk factors associated with HDP, yet the potential impact of perinatal behaviors on HDP outcomes in the Southern African context has received limited attention. Contradictory findings from systematic analyses of studies conducted in Sub-Saharan Africa (SSA) and European countries have underscored the complexity of the relationship between a range of maternal nutrition habits, physical activity, tobacco use, and HDP (Meazaw et al., 2020a; Schoenaker et al., 2014). These disparities in findings are often attributed to variations in population characteristics such as ethnicity, nutritional status, and economic development (Meazaw et al., 2020a; Schoenaker et al., 2014).

A notable limitation of studies conducted in SSA, particularly in regions such as East, West, and Central Africa, is their primary focus on hospital facilities and relatively small sample sizes (Meazaw et al., 2020a; 2020b). As a result, these findings may not accurately reflect the situation in Southern African countries, where distinct socioeconomic, demographic, and geographic differences contribute to varying risk factors associated with HDP.

Given these nuanced disparities and the critical role of perinatal behaviors in influencing HDP outcomes, it is imperative to comprehensively investigate the specific impact of these behaviors within the Southern African context.

1.3 Research question and sub-questions:

Main Research Question:

What is the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women in selected Southern African countries?

Sub-Questions:

1. What is the prevalence of hypertensive disorders among pregnant and postpartum women in South Africa, Namibia, and Lesotho?

2. What is the association between peri-natal behaviors and hypertensive disorders among pregnant and postpartum women in South Africa, Namibia, and Lesotho?

1.4 Research objective and sub-objectives

Main Research objective:

To investigate the relationship between perinatal behaviors and hypertensive disorders among pregnant and postpartum women in selected Southern African countries.

Sub-objectives:

1. To determine the prevalence of hypertensive disorders among pregnant and postpartum women in South Africa, Namibia, and Lesotho?

2. To investigate the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women in South Africa, Namibia, and Lesotho?

1.5 Justification:

Hypertension during pregnancy is not uncommon, but its increased incidence has been linked to a significant rise in cardiometabolic illnesses in younger women globally (Umesawa & Kabashi, 2017; Ying et al., 2018). Remarkably literature has reported that deaths and years living with cardiometabolic illness are highest in the 25-29 age range, followed by 30 to 34 (Wang et al., 2021). This has implications for the ability of women to be productive in the economy. Nutrition transition accompanied by urbanization in most Southern African countries may account for the increase in the non-communicable disease burden (Nnyepi et al., 2015; Unwin et al., 1999). Notably, HDP risk varies by population and geography, and low-resource environments have been associated with multi-nutritional and dietary inadequacies (Meazaw et al.,2020a; Nnyepi et al., 2015).

Consequently, the socioeconomic disparities across Southern African Countries (SACs) contribute to the non-communicable diseases (NCD) problem. For instance, despite South Africa being an upper-middle-income country with advanced healthcare facilities, it has enormous economic inequalities, with over 20% of its population living in extreme poverty, which may limit their capacity to buy nutritious food (Symington et al., 2018). Similarly, Namibia had more than 20% of the population found themselves without employment, with a predominant impact on women and young individuals in 2021 (World Food Programme, 2023). The 2022 Global Hunger Index revealed that Namibia grapples with a significant hunger issue, landing it in the 78th position among 116 nations surveyed (World Food Programme, 2023; Christian, 2020). Lesotho's limited health care system, food instability, and poor diet may also contribute to adult nutrition deficits (Lesotho Food and Nutrition Coordinating Office, 2016). The World Bank, in collaboration with the Lesotho Bureau of Statistics, conducted a joint assessment of poverty in Lesotho. Their findings indicate a reduction in poverty from 56.6% to 49.7% between 2002 and 2017 (World Bank, 2019). This improvement, however, is overshadowed by ongoing challenges such as recurring crop failures, low incomes, and elevated food prices. Notably, 41% of rural households now allocate more than half of their income to food expenses (World Bank, 2019). Hence, examining patient-related practices and factors outside health care institutions' problems will help solve HDP from multiple perspectives.

Using population-based data, research like this can improve hypertension prevention and management in Southern Africa by informing policies related to pregnant women and, by extension, those who would have recently given birth. One such policy is South Africa's 2019 National Guidelines on HDP, which aims to improve clinical care and management of pregnant women with HDP. While Lesotho and Namibia lack explicit policies that directly address hypertension during pregnancy, they also have Comprehensive Emergency Obstetric and Neonatal Care (CEONC) and Standard Antenatal Care guidelines that promote the prevention and care of mothers at increased chances of HDP, respectively. Nonetheless, most SACs lack context-specific pregnancy nutrition guidelines, and most of their policies neglect postpartum women at risk of experiencing persistent pregnancy-induced hypertension. Hence, this research may inform the development of context-specific dietary recommendations for pregnant and postpartum women that may be incorporated into HDP management guidelines, national maternity care guidelines, and BANC prevention efforts. Moreso, this research will reduce maternal and infant mortality by providing evidence-based research for HDP efforts. Due to

HDP’s public health challenges and the worldwide commitment to reducing maternal and neonatal mortality, this study is relevant for the progressive achievement of SDG 3. Targets 3.1 and 3.2 of the Sustainable Development Goals aim to reduce maternal mortality to 70 deaths per 100,000 live births and neonatal mortality to 12 deaths per 1000 live births by 2030.

Scholarship has shown that little is known about the preventative role of various perinatal behaviors in Southern Africa. In fact, while several European research have revealed no correlation between a good diet rich in fruits and vegetables and HDP outcomes, data from studies in sub-Saharan Africa have been either inconclusive or suggestive of an increased risk of developing HDP. (Arvizu et al., 2020 ; Atkinson et al., 1998 ; Fulay et al., 2018; Mwanri et al.,2015; Wiertsema et al., 2021;). Given the inconclusive evidence stemming from various studies concerning the potential protective impact of distinct perinatal behaviors on Hypertensive Disorders of Pregnancy (HDP), it becomes imperative to clarify the scope of this research. This study does not solely revolve around investigating the protective role of perinatal behavioral patterns on HDP outcomes among pregnant and postpartum women. Instead, its focus is to comprehensively examine the complex relationship between these perinatal behaviors and the occurrence of HDP. By exploring this multifaceted association, the research seeks to elucidate the broader influence of perinatal behaviors, encompassing both potential protective and deleterious effects, on the development of HDP.

The selection of countries was based on firstly the variable of interest blood pressure measurements Southern Africa was selected as the location for the study on the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women due to the availability of the variable of interest, blood pressure measurements, and the geographical alienation of Southern Africa. Hypertensive Disorders of Pregnancy (HDP) are common complications of pregnancy globally, including sub-Saharan African (SSA) countries. However, evidence on the risk of the problem is limited.

There are several studies on the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women that did not give attention to Southern African countries. For example, a population-based study by Wang et al. (2021) focused on epidemiological trends of maternal hypertensive disorders of pregnancy at global, regional, and national levels from 1990 to 2019 by age and sociodemographic index. Another study by Bromfield et al. (2023) evaluated the association of hypertensive disorders compared to no hypertension during pregnancy with neonatal and maternal outcomes. These studies provide valuable insights into the global burden of hypertensive disorders of pregnancy but did not specifically focus on Southern African countries.

Chapter 2: Literature Review and Theoretical Framework

2.1 Introduction

In this chapter, we delve into a comprehensive exploration of the most recent literature surrounding Hypertensive Disorders of Pregnancy (HDP) within the context of Sub-Saharan Africa (SSA). HDP remains a critical concern for maternal health, posing substantial challenges to both national and global maternal mortality reduction goals. Understanding the intricate web of factors contributing to the development of HDP is vital for targeted interventions and improved maternal health outcomes. This chapter provided a thorough review of literature concerning the association between HDP and various socioeconomic, demographic, and behavioral factors, shedding light on the complexity of HDP prevalence and determinants within SSA. It provides an in-depth analysis of the factors contributing to the occurrence of Hypertensive Disorders of Pregnancy, shedding light on the multifaceted nature of HDP within Sub-Saharan Africa. Through the structured examination of socioeconomic, demographic, behavioral factors, and theoretical frameworks, the study aims to pave the way for a thorough understanding of HDP's determinants and inform targeted interventions for improved maternal health outcomes. This chapter also provides a brief description of McCarthy & Maine, 1992 Framework for Analyzing the Determinants of Maternal Mortality and Morbidity and how it was adapted for this study.

2.2 Recent Literature Review on HDP and Associated Socioeconomic and Demographic Factors

The current section delves into an extensive analysis of recent literature concerning Hypertensive Disorders of Pregnancy (HDP) and its relationship with various socioeconomic and demographic factors. In doing so, this review seeks to engage in a dynamic dialogue with prior authors by addressing gaps in their research and elucidating the novel contributions of this study.

Maternal Age: A series of studies have underscored maternal age as a key independent predictor of HDP development (Mwanri et al., 2015; Omenya et al., 2018; Owiredu et al., 2012; Pierre Marie et al., 2011; Tebeu et al., 2011). For instance, a Chinese study highlighted elevated HDP risks for pregnant women aged 35–39 and 40 years and older, revealing risks 1.8 and 2.4 times greater, respectively, compared to those aged 20–24 (Ye et al., 2014). Additionally, teenage pregnancies were also linked to a higher risk of eclampsia-related mortality (Nathan et al., 2018; Ngene & Moodley, 2020). Therefore, maternal age should be a variable that we should consider when investigating determinants of HDP especially in the context of increase in teenage pregnancies in Southern Africa.

Maternal Education: Examining the connection between a mother's educational level and HDP occurrence, several studies have unveiled significant insights (Mokenon et al., 2018; Omenya et al., 2018; Pierre Marie et al., 2011; Temesgen, 2017). Notably, a consistent trend emerged, highlighting a positive correlation between lower education levels and the likelihood of experiencing HDP in contrast to those with higher educational backgrounds (Mokenon et al., 2018; Temesgen, 2017; Zhao et al., 2021). Furthermore, it is widely agreed upon in the literature that higher maternal education enhances awareness of pregnancy-related health matters, influencing women's decisions to seek medical attention (Temesgen, 2017; Zhao et al., 2021). We also adopt the same variable to better understand the role ofmaternal education in mitigating HDP.

Employment Status: Diverse evidence concerning the relationship between employment status and HDP risk has emerged. While some studies found housewives to be at a heightened risk, others revealed elevated HDP frequency among employed pregnant women, particularly those working more than 40 hours per week or in specific roles (Kibret et al., 2020; Meazaw, 2020a; Pierre Marie et al., 2011; Landsbergis, 1996; Spracklen et al., 2016; Spinillo et al., 1995). Yet, contrasting results suggest no significant connection between employment and HDP risk in pregnant women (Chang et al., 2009). Due to these inconsistencies in scholarship on the contribution of the mothers employment status to HDP it becomes important to also understand how their status relates to HDP in the selected SSA countries.

Place of Residence: The influence of residence on HDP incidence remains contentious. While some studies suggested higher odds of HDP among urban women, others indicated a contrary trend, with rural residents facing greater prevalence (Mwanri et al., 2015; Hinkosa et al., 2020; Wolde et al., 2011; Ye et al., 2014; Zhao et al., 2021). Given the inconsistent findings in the academic literature on the impact of a mother's place of residence on hypertensive disorders of pregnancy (HDP), it is essential to investigate the relationship between place of residence and HDP in selected sub-Saharan African countries.

Marital Status: Although numerous studies exploring the marital status-HDP link found statistically insignificant outcomes, evidence hints at a positive correlation between not being married and HDP risk (Kahsay et al., 2018; Owiredu et al., 2012; Larry et al., 2017). Notably, a study from Ghana indicated a more than threefold rise in HDP risk for women planning subsequent pregnancies with their current partner after already having a child (Owiredu et al., 2012). Given these findings, it then becomes important to include the variable of marital status in future studies on HDP. Marital status may be a potential key factor in reducing HDP risk, and further research is needed to confirm this association.

2.3 Health and Reproductive Status as Determinants of HDP

Parity: Studies examining the relationship between parity and HDP occurrence show divergent conclusions. First pregnancies were associated with heightened HDP risk, while multiparous mothers also demonstrated an increased likelihood of developing HDP in certain cases (Ayala & Hermida, 2001; Hernández-Díaz et al., 2010; Moodley et al., 2016; Azubike & Danjuma, 2017; Mbouemboue et al., 2016). Factors such as the number of pregnancies and a history of HDP contribute to these varying outcomes.

Pre-existing Health Conditions: Underlying health conditions like diabetes and chronic hypertension emerge as notable independent predictors of HDP (Bilano et al., 2014; Duckitt & Harrigton, 2005; Kahsay et al., 2018; Suleiman et al., 2014). Persistent hypertension, especially, increases the likelihood of acquiring HDP.

Prior History of Pregnancy Complications: A history of abortion, pre-term pregnancy, and c-section delivery has been linked with HDP occurrence (Hinkosa et al., 2020; Sharami et al., 2017; Xiong et al., 2002). Though abortion was found to enhance subsequent pregnancies' safety, the relationship between pre-term pregnancy and HDP remains nuanced.

Body Mass Index (BMI): High BMI emerges as a significant risk factor for HDP (Owiredu et al., 2012; Kahsay et al., 2018; Singh et al., 2014). Overweight or obese women face an elevated HDP risk compared to those with a normal BMI. However, contrasting findings also suggest no association or even an increased HDP risk for those with healthy dietary patterns (Eshriqui et al., 2016; Fulay et al., 2018; Mwanri et al., 2015; Timmermans et al., 2011).

Evidence indicate parity, pre-existing health conditions, prior pregnancy complications, and BMI are all important factors in the current study. These factors can increase the risk of HDP. This study adopts these factors to determine the level of risk associated with HDP to recommend and develop interventions.

2.4 Behavioral Factors Related to HDP

Perinatal behaviors refer to the actions and habits that women adopt during pregnancy and after giving birth that may affect their health and well-being (Goodman 2019). These practices may include seeking antenatal care, following a healthy diet, avoiding substance use, engaging in physical activity, coping with stress, breastfeeding, and bonding with the baby. Goodman (2019) further eludes that perinatal behaviors are influenced by various factors such as personal beliefs, cultural norms, social support, economic status, and access to health services. In this study, perinatal behaviors are defined as the self-reported behaviors of women in the perinatal period that are related to their physical and mental health outcomes.

Dietary Habits: Maternal nutritional status significantly impacts maternal and infant health outcomes (Symington et al., 2018). The influence of dietary habits on HDP is a subject of ongoing investigation, with varying conclusions. Some studies propose that a diet rich in fruits and vegetables can reduce HDP odds (Kibret et al., 2018; Jiang et al., 2019), while others report no connection or even elevated risk (Eshriqui et al., 2016; Fulay et al., 2018; Mwanri et al., 2015; Timmermans et al., 2011; Atkinson et al., 1998). Notable methodological disparities and diverse populations contribute to these contrasting findings.

Physical Activity: Engaging in physical activity during pregnancy is generally associated with reduced HDP risk, although disparities between regions are evident (Davenport et al., 2018; Pearson et al., 2015). Moderate to intense physical activity has shown to be protective, leading to reduced odds of HDP (Covet et al., 2018; Davenport et al., 2018; Kasawara et al., 2012; Spracklen et al., 2016).

Smoking: Tobacco smoking's impact on HDP varies, with some studies indicating a decreased occurrence of pre-eclampsia, while others show no significant association (England and Zhang, 2007; Leeners et al., 2006; Marcoux et al., 1989; Wei et al., 2015; Sharma et al., 2022).

Prevalence of HDP in Sub-Saharan Africa: The prevalence of HDP in the SSA region is reported to be notably higher than in other regions, emphasizing a critical need for understanding and addressing this burden (Gemechu et al., 2020). Pooled prevalence estimates range between 5.2% and 10%, indicating substantial regional variation (Umesawa and Kobashi, 2017; Noubiap et al., 2019; Nyaga et al., 2018; Berhe et al., 2018; Tesfa et al., 2020; Oladele, 2018; Muti et al., 2015; Miller et al., 2022).

The influence of dietary habits, physical activity, and smoking on HDP is a subject of ongoing investigation, with varying conclusions. Some studies suggest that a diet rich in fruits and vegetables can reduce HDP odds, while others report no connection or even elevated risk. Engaging in physical activity during pregnancy is generally associated with reduced HDP risk, although disparities between regions are evident. Tobacco smoking's impact on HDP varies, with some studies indicating a decreased occurrence of pre-eclampsia, while others show no significant association.

These factors could be important in the current study because they are all modifiable and could potentially be targeted for interventions to reduce the risk of HDP. For example, women could be encouraged to eat a healthy diet, engage in physical activity, and avoid smoking during pregnancy. Additionally, the study could explore the role of cultural norms and social support in influencing perinatal behaviors.

The prevalence of HDP in Sub-Saharan Africa is reported to be notably higher than in other regions, emphasizing a critical need for understanding and addressing this burden. The current study will contribute to this effort by examining the role of dietary habits, physical activity, smoking, and other perinatal behaviors in HDP in this SAC region.

2.5 Theoretical Framework for the Study

This study utilizes an analytical framework by McCarthy & Maine (1992), originally designed to analyze the contributing factors of maternal mortality. Critical arguments of the theory are that determinants of and all efforts to reduce maternal mortality and, by extension, maternal morbidity must function through a series of only three intermediate outcomes. Research efforts and program interventions must either; lower the chance of a woman becoming pregnant, reduce the risk of a pregnant woman experiencing a significant problem during pregnancy or delivery, or improve the pregnancy and childbirth outcomes for women with complications (McCarthy & Maine, 1992). The theory identifies social, behavioral, cultural, biological, and economic factors, grouped into two main categories: intermediate and distant factors (McCarthy & Maine, 1992). The framework three stages (pregnancy, complications, and disability or death) that result in maternal mortality or morbidity directly influenced by a set of intermediate factors. A woman's health state, reproductive status, access to health services, collection of unknown variables, and healthcare behavior and use are five intermediary factors that directly influence the chance of her dying from complications of pregnancy and delivery (McCarthy & Maine, 1992). The distal determinants, namely socioeconomic and cultural, operate through the intermediate factors influencing maternal health outcomes. Specifically, these include woman’s status, household, and community status.

A number of studies have examined the development of obsteric fistula using the McCarthy and Maine’s conceptual approach (Sih et al.,2016; Washington et al.,2015; Wall, 2012). For instance, a study by Wall (2012) utilized McCarthy and Maine’s (1992) conceptual approach to examine obstructed labor and the development of obstetric fistula. According to Wall (2012), this framework initially established to evaluate the determinants of maternal death was relevant because much of what is known about preventing maternal mortality is also immediately applicable to preventing obstetric labor and fistulas. McCarthy and Maine (1992) further suggest that the approach can analyze factors linked with pregnancy and childbirth-related chronic illness. Consequently, HDP is a prevalent adverse condition that may arise from pregnancy and childbirth that can be investigated using this approach.

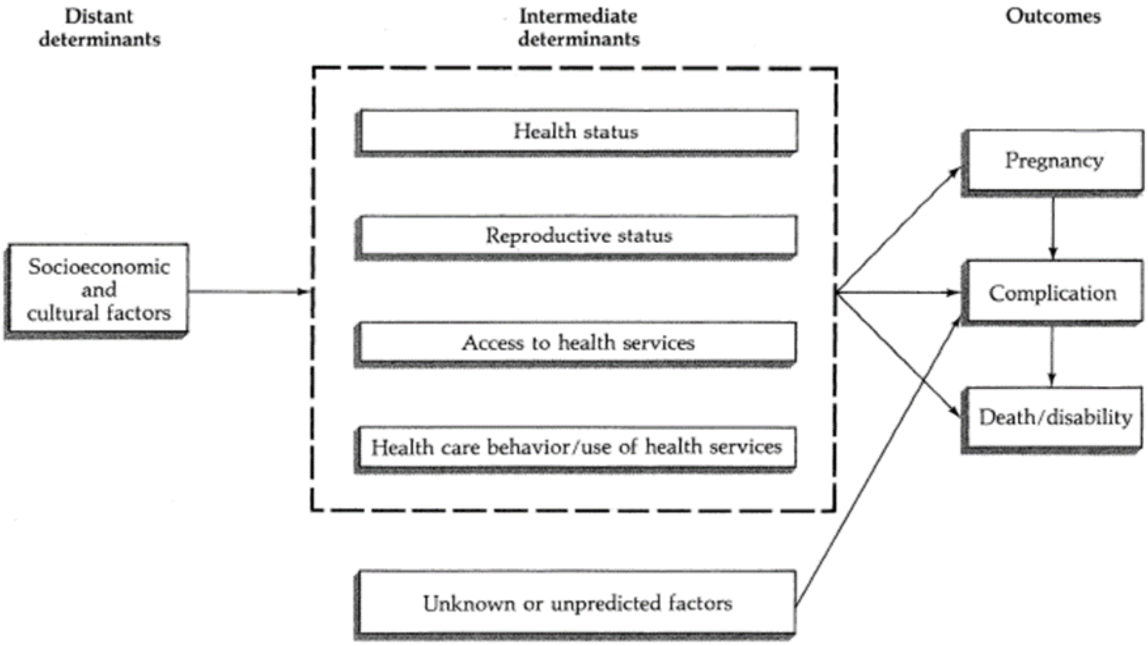


Figure 2.1: McCarthy & Maine, 1992 Framework for Analyzing the Determinants of Maternal Mortality and Morbidity

2.6 Conceptual framework for the study

In light of the findings from the literature examined on variables related to HDP in SSA, McCarthy and Maine's (1992) Framework for Analyzing Maternal Mortality Determinants guided the conceptual framework for this inquiry. This conceptual framework takes into consideration both distant and intermediate variables that contribute to maternal morbidity. This study's framework incorporates the roles of sociodemographic, biological, and behavioral factors on HDP. The study's conceptual framework's overarching goal is to identify behavioral characteristics that might lessen or increase a woman's risk of severe complications during and immediately after pregnancy. Since McCarthy and Maine's (1992) framework does not account for all distant and intermediate determinants of maternal morbidity described in the literature, they have been incorporated into the study's conceptual framework. Specifically, sociodemographic factors that reflect one's position in society, namely, age, place of residence, educational status, employment status, and marital status, would be included in this study. Also, alterations have been made to several factors described by the original framework to ensure they fulfill the research criteria. Specifically, healthcare behavior has been modified in this study to include physical activity, tobacco use, consumption of fruits and vegetables, and iron supplements instead of only healthcare utilization. Hence maternal nutritional status for this study extends beyond the Framework for Analyzing Maternal Mortality Determinants

(FAMMD) definition of anemia to assess the dietary behaviors among pregnant and postpartum women, as shown in Figure 2.2 below.

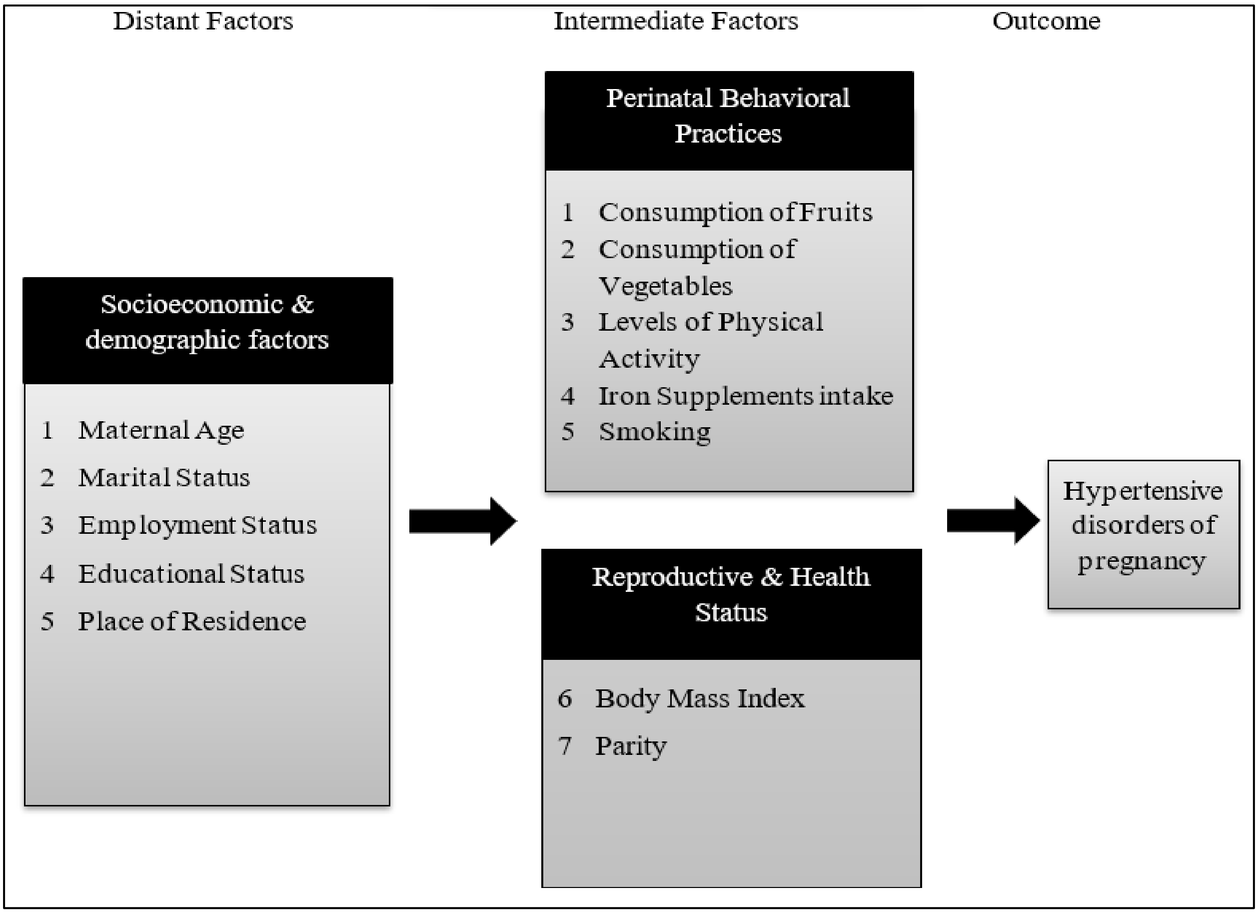


Figure 2. 2: Conceptual Framework Analysing Factors Associated with Hypertensive Disorders of Pregnancy adapted from McCarthy & Maine 1992 Framework of Analyzing Determinants of Maternal Mortality & Morbidity

2.7 Research hypotheses

Null Hypothesis (Ho)

- There is no relationship between perinatal behaviors and HDP.

Alternative Hypothesis (Hi)

- There is a relationship between perinatal behaviors and HDP.

Chapter 3: Methodology

3.1 Study area

The study was conducted in three Southern African countries: Lesotho, South Africa, and Namibia. The populations of these countries are estimated at 2.2 million, 60.6 million and 2.5 million, respectively (World Bank, 2022; Statistics South Africa, 2022; Statistics Times, 2021). Females make up a majority of the population in all three countries where over 50% of the population consist of females. The urban populations of Lesotho and Namibia are significantly lower than their rural populations, while South Africa has a more even distribution of urban and rural populations (Lesotho Bureau of Statistics, 2016; Statistics South Africa, 2022).

Cardiometabolic illnesses during pregnancy are not uncommon in these countries. Of note, the socioeconomic disparities across Southern African Countries (SACs) contribute to the non-communicable diseases (NCD) problem. Despite South Africa being an upper-middle-income country with advanced healthcare facilities, it has enormous economic inequalities, with over 20% of its population living in extreme poverty, which may limit their capacity to buy nutritious food (Symington et al., 2018). Recent studies showed that nearly 50% of South African women were economically inactive compared to 35.6% for men (Statistics South Africa, 2022).

Similarly, Namibia despite being classified as an upper middle income country, nearly 18% of the population live below the national poverty line and more than 20% of the population was unemployed with a predominant impact on women and youth in 2021(World Food Programme, 2023). The 2022 Global Hunger Index revealed that Namibia grapples with a significant hunger issue, landing it in the 78th position among 116 nations surveyed (World Food Programme, 2023). The country is also witnessing an obesity crisis with rates exceeding the regional average, affecting 20.8% of women compared to 9.2% of men (Christian, 2020).

Lesotho's limited health care system, food instability, and poor diet may also contribute to adult nutrition deficits with close to 50% of its population living in extreme poverty (Lesotho Food and Nutrition Coordinating Office, 2016; World Bank, 2019). The World Bank, in collaboration with the Lesotho Bureau of Statistics, conducted a joint assessment of poverty in Lesotho in which 49.7% of the population in Lesotho are living under extreme poverty a reduction from nearly 60% from 2017 (World Bank, 2019). This improvement, however, is overshadowed by ongoing challenges such as recurring crop failures, low incomes, and elevated food prices. Notably, 41% of rural households now allocate more than half of their income to food expenses (World Bank, 2019).

3.2 Study design and data source

This study adopted a cross-sectional approach utilizing secondary data from the most recent population-based Demographic and Health Survey (DHS) programs for South Africa (2016), Namibia (2013), and Lesotho (2014) by appending their respective datasets. Every five years, the DHS program conducts national surveys in LMICs, providing the most regular, comparable information through time and across countries on essential demographic and health indicators, such as maternal health and disease prevalence among all population groups. Individuals recode (IR), Adult health recode, and Person recode (PR) are among the data files utilized in this investigation. The Individual Recode data file used to store information about women of reproductive age (15 to 49), their overall health, reproductive history, demographic characteristics and health behaviors formed the master file for this study. While the adult health and person recode, files were using files. Specifically, the person recode file was used because it contained the health measurements data for women namely blood pressure measurements and BMI which were relevant for this study. Because some of the health-related behavioural questions were not recorded in the individual record file, the adult recode file was a source of information for questions on consumption of fruits and vegetables.

3.3 Study population and sample size

Reproductive women aged 15-49 years who were pregnant at the time of the survey and those who had given birth a year before and in the month of the survey made up the study population. Recent studies have confirmed that pregnancy-induced hypertension can persist for up to three months, six months, or one year in LMICS (Nakimuli et al., 2013; Nganou-Gnindjio et al., 2021; Ishaku et al., 2021). Based on this knowledge, the study population included respondents who gave birth a year before and in the survey month. The following question in the DHS was used to identify pregnant women for this study; Are you currently pregnant? (v213). To identify those who gave birth during the month of the survey - (v210) – the total number of births in the month of the interview was used, and for those who gave birth a year before the survey - (v209) – the total number of births in the past year. After merging and appending each country's Individual Recodes with Person Recodes, there were 4488 study participants. Of these, only 1273 had complete blood pressure measurements and information on their hypertension status. Of these 1273 participants, 667 were from Lesotho, 185 were from Namibia, and 421 were from South Africa.

3.4 Variables

3.4.1 Demographic variables

In a study of the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women the demographic variables hare been noted to be of paramount importance. Previous studies (Tchouaket et al., 2013 Said-Mohamed et al., 2015) have indicated these variables with maternal health and birth outcomes. For example, a study conducted by Said-Mohamed et al. (2015) found that food insecurity, socioeconomic status, pregnancy-associated hypertension, pre-eclampsia, gestational diabetes, and mixed ancestry were associated with lower infant gestational age while maternal BMI at enrolment was associated with higher infant gestational age. Another study found that maternal obesity in Africa ranged from 6.5 to 50.7%, with older and multiparous mothers more likely to be obese. Obese mothers had increased risks of adverse labour, child and maternal outcomes. These findings suggest that the inclusion of these variables in the study can provide valuable insights into the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women.

3.4.2 Outcome/ dependent variable

This study's outcome of interest was the different hypertensive disorders of pregnancy measured as a single outcome. The results from an average of the last two blood pressure readings taken during the survey determined the outcome of interest. The outcome was coded as a binary variable. For this study, study participants were classified as having HDP if they had a systolic blood pressure (sBP) $\geq$ 140 mmHg and diastolic blood pressure (dBP) $\geq$ 90 mmHg. The classification was done according to internationally accepted standards provided by the International Society of the Study of Hypertension in Pregnancy (ISSHP) (Brown et al., 2018). From the three blood pressure readings of participants taken during the survey, an average of the two BP was recorded as someone with BP, including those currently taking antihypertensive medication to control their blood pressure. Hence any limitations related to sudden blood pressure spikes that might arise have been eliminated. Further validation of the BP results was conducted by cross-checking the BP results and a question on whether the respondent had been told they had hypertension before. Table 3.1, presented below with blood pressure categories, was produced by the DHS team that classified respondents as hypertensive. Hence, as detailed below, this study recategorize the blood pressure category results from the person record question sh244 (blood pressure category result).

Table 3. 1: Definition and Classification of the dependent variable

Survey Blood Pressure Category	**Study Blood Pressure Categorization**
1.normal (optimal) (sBP) <120 & (dBP) <80	0. No HDP (sBP) <139 OR (dBP) < 89
2. normal (mildly high) (sBP) 120-129 OR (dBP) 80-84	1. Hypertensive Disorders of Pregnancy (sBP) 140-180+ OR (dBP) 90-110+
3. normal (moderately high) (sBP) 130-139 OR (dBP) 85-89	
4. abnormal (mildly elevated) (sBP) 140-159 OR (dBP) 90-99	
5. abnormal (moderately elevated) (sBP) 160-179 OR (dBP) 100-109	
6. abnormal (severely elevated) (sBP) 180+ OR (dBP) 110+	

3.4.3 Independent variables

Table 3. 2: Independent variables used in this study

Study Variable name	Survey Variable name	Survey categorization	Study categorization
Socioeconomic and demographic variables			
1. Maternal age	v013 Age in group	1)15-19 2)20-24 3)25-29 4)30-34 5)35-39 6)40-44 7) 45-49	1)15-24 2)25-34 3)35-49
2. Body Mass Index	v445	1. - 5728 (continuous)	1)normal weight 2)overweight 3)obese
3. Marital Status	V501 Current marital status	0)never in the union 1)married 2)living with a partner 3)widowed 4)divorced 5)no longer living together/separated	0)never married 1)ever married [married/living with a partner/widowed/ divorced/separated]
4. Place of residence	V025 Type of place of residence	1)Urban 2)Rural	0)Urban 1)Rural

5. Educational Status	V106 the highest educational level attained	0)No Education 1)Primary 2)Secondary 3)Higher	0)No Education 1)Primary 2)Secondary 3)Higher
6. Employment Status	v714 respondent currently working	0)No 1)Yes	0)No 1)Yes
7. Parity (number of pregnancies)	v220 living children + current pregnancy (grouped)	(1) – 6+	1)One to two 2)Three to four 3)five or more
Main Predictor Variables: Perinatal Behaviors			
8. Taking Iron Supplements	m45_1 During pregnancy, given or bought iron tablets/syrup	1)No 2)Yes 3) Don't know	0)No 1)Yes
9. Consumption of fruits	s1309 Number of times eaten fruits in a week	none 1 – 15	0)No fruits eaten 1)fruits eaten
10. Consumption of vegetables	S1310 Number of times eaten vegetables in a week	none 1 – 15	0)no vegetables eaten 1)vegetable eaten
11. Occupation Types	V717 Respondent's Occupation Grouped	0)Not working 1)Professional/technical/manageria l 2)Clerical 3)Agricultural self-employed 4)Agricultural unskilled 5)Household & domestic 6)Services 7)Skilled manual 9)Unskilled manual 10) Don't know	0)Low Physical Inactivity 1)Intense Physical Activity
12. Smoking Status	V463z does not use cigarettes and tobacco Does not use cigarettes and tobacco	0)No 1)Yes, smokes nothing	0) Non-smoker 1) Smoker

Table 3.2 above presents this study's explanatory variables, which consisted of socio-economic and demographic and reproductive and health status factors as control variables. At the same time, perinatal behavioral factors are classified as the main predictor variables assessed for their influence on the outcome variable. Control variables including maternal age (grouped in 10-year age groups), educational attainment (captured as no education, primary, secondary, and higher education), employment status was maintained as a binary response (working & not working), place of residence (categorized into rural and urban) and body mass index were recategorized to normal, overweight and obese. Participants with a BMI of 18.5 to 24.9 fell within the normal/healthy weight, overweight respondents had a BMI range of 25.0 to 29.9, and a BMI of greater and equal to 30 was categorized as obese. Literature on the determinants of HDP guided the selection of the socioeconomic and demographic variables as control variables because of their effects on HDP outcomes. Of note, maternal age has been noted as a significant predictor of HDP whereby women over the age of 35 are at higher risk of developing HDP compared to the younger age groups. Similarly, educational attainment, place of residence, is considered a significant predictor of HDP outcomes. Overweight or obese women face an elevated HDP risk compared to those with a normal BMI.

Perinatal behaviors are variables of interest to this study were those maternal habits noted in the literature to be protective against developing HDP in some context while other research studies have not found them to be harmful. These included consuming fruits and vegetables, smoking during pregnancy, taking iron supplements, and level of physical activity. Notably, fruits and vegetable consumption variables were recategorized as binary responses (not eaten or eaten vegetables and fruits). Binary responses were also maintained for the variable iron supplement intake and smoking. This study used occupation types as a proxy measure for physical activity levels. More precisely, individuals falling into categories such as professional, technical, managerial, clerical, household/domestic, and service-related occupations were designated as having low physical activity levels. Conversely, participants engaged in skilled manual labor, unskilled manual labor, agricultural work, and agriculture self-employment were categorized as individuals undertaking intense physical activity in the form of manual labor.

In a study of the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women the demographic variables hare been noted to be of paramount importance. Previous studies (Tchouaket et al., 2013; Said-Mohamed et al., 2015) have indicated these variables with maternal health and birth outcomes. For example, a study conducted by Said-Mohamed et al. (2015) found that food insecurity, socioeconomic status, pregnancy-associated hypertension, pre-eclampsia, gestational diabetes, and mixed ancestry were associated with lower infant gestational age while maternal BMI at enrolment was associated with higher infant gestational age. Another study found that maternal obesity in Africa ranged from 6.5 to 50.7%, with older and multiparous mothers more likely to be obese. Obese mothers had increased risks of adverse labour, child and maternal outcomes. These findings suggest that the inclusion of these variables in the study can provide valuable insights into the association between perinatal behaviors and hypertensive disorders among pregnant and postpartum women.

3.5 Data Analysis plan

This study's data was managed and analyzed using STATA (v14.1). The data analysis approach followed the study's objectives to provide descriptive and analytical judgments.

Objective 1: To determine the prevalence of hypertensive disorders of pregnancy in the three Southern African countries by the socioeconomic, demographic, and behavioral factors. Tables with the frequency, percentage and chi-square statistical tests were performed to determine the levels of HDP among study participants by socioeconomic, demographic, and perinatal behavioral factors selected for the study. The following formula was used to calculate the chi-square:

$$\chi^2 = \sum (O_i - E_i)^2 / E_i$$

Where the Chi-Square is denoted by χ^2 and

O_i = observed value (actual value)

E_i = expected value.

Objective 2: To investigate the association between perinatal behaviors and hypertensive pregnancy disorders among pregnant and postpartum women in three Southern African countries.

Given that the outcome was categorized as a binary variable, it was sufficient to approach the objective with a binary logistic regression model producing odds ratios. An initial unadjusted binary logistic regression analysis was conducted to check for the independent and crude association of the explanatory variables with the outcome. The statistical significance of regression analyses was set at a p-value of less than 0.05. The odds ratio and corresponding 95% confidence interval for each predictor variable in the model were interpreted. Following the unadjusted model, the adjusted model was performed to determine the association between perinatal behaviors and the odds of HDP at the multivariate level. Before running the adjusted regression model, a diagnostic test for possible multicollinearity of predictor variables was performed to evaluate the potential confounding relationship between explanatory variables using the powcorr method. Correlation coefficients below 65% indicated that the predictor variables were not significantly connected. The formula below was used for the logistic regression model. In my study, **p(x)/1-p(x)** represents the probability of occurrence and non-occurrence of HDP. It shows the likelihood that a participant has HDP or didn't have HDP given a combination of the selected perinatal behaviors (b1x1+b1x2+b1x3……).

$$[\frac{p(x)}{1-p(x)} = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots$$

3.6 Ethics

The Demographic and Health Survey program is a secondary data source that has been anonymized before being disseminated. Given that permission to use the data was granted per the DHS International microdata public access rules, which offer essential protection to participants' privacy, any ethical issues related to confidentiality and privacy were not breached. Moreso, the researcher did not make any effort to identify study participants. Instead of seeking ethical clearance, an ethics waiver approval (Ethics Waiver Number 407525/3705135) was obtained from the Human Research Ethics Committee Non-Medical that authorized this study and confirmed that there would be little to no ethical issues violated by this investigation.

Chapter 4: Results

This study was undertaken with the aim of investigating the association between perinatal behaviors and Hypertensive Disorders of Pregnancy (HDP) among pregnant women and those who had given birth within a year prior to the survey in selected countries in Southern Africa. Furthermore, the study aimed to evaluate the prevalence of HDP within these countries while considering factors such as socioeconomic status, demographic attributes, and perinatal behavioral patterns.

4.1.1: Characteristics of study participants

Table 4. 1: Distribution of study participants by socioeconomic, demographic & perinatal behavioral characteristics

Characteristics	All participants N (%)
	1273 (100)
Age (years)	
15 - 24	597 (46.90)
25 - 34	496 (38.96)
35 - 49	180 (14.14)
BMI Category	
Normal Weight 18.5-24.9 kg/m2	524 (48.93)
Overweight 25.0-29.9kg/m2	333 (31.09)
Obese >30.0kg/m2	214 (19.98)
Marital Status	
Never married	453 (35.59)
Ever Married	820 (64.41)
Place residence	
Rural	819 (64.34)
Urban	454 (35.66)
Education Status	
no education	31 (2.44)
Primary	397 (31.19)
Secondary	741 (58.21)
Higher	104 (8.17)

Employment Status	
Not working	935 (73.45)
Working	338 (26.55)
Iron Supplements Intake	
No	165 (16.48)
Yes	836 (83.52)
Fruits Consumption	
No fruits eaten	293 (50.60)
Fruits eaten	286 (49.40)
Vegetable Consumption	
No vegetables eaten	207 (35.08)
Vegetables eaten	383 (64.92)
Occupation types	
low physical activity	696 (84.06)
Intense physical activity	132 (15.94)
Smoking status	
Non-Smoker	1,102(93.00)
Smoker	83 (7.00)

Table 4.1 above summarizes the socioeconomic, demographic, and peri-natal behavioral characteristics of study participants in the sample. Regarding health-related behaviors, 83.52% of participants reported taking iron supplements, and similar proportions were observed for fruits consumption (49.40% consumed fruits) and vegetable consumption (64.92% consumed vegetables). In terms of physical activity levels, 84.06% reported low physical activity among participants engagement, while 15.94% engaged in intense physical activity. Lastly, the majority were non-smokers (93.00%), with 7.00% reporting being smokers.

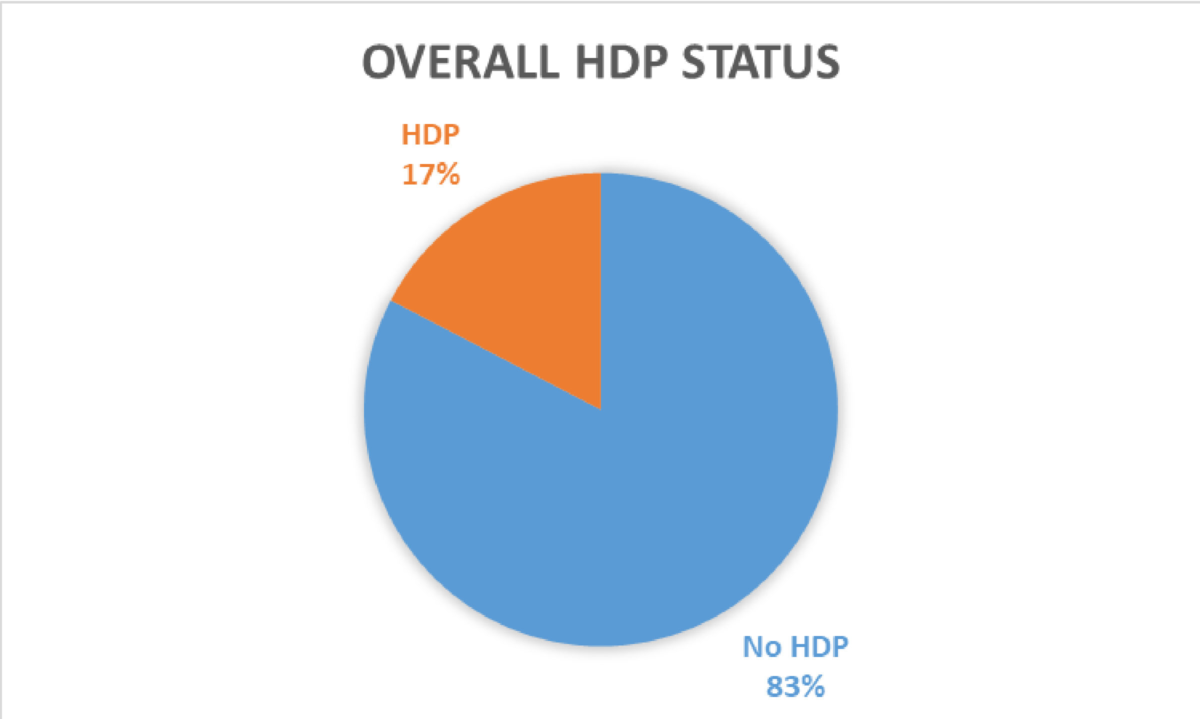
The provided results detail the characteristics of the participants in the study. Out of a total of 1273 participants, the majority fell within the age range of 15-25 years (50.51%), with 26-35 years and 36-49 years age groups constituting 37.47% and 12.02% respectively. The distribution of participants based on BMI categories shows that 48.93% were classified as having a normal weight (BMI 18.5 to 24.9kg/m2), 31.09% were overweight (BMI 25.0-29.9kg/m2), and 19.98% were obese (BMI > 30.0kg/m2). In terms of marital status, 35.59% of participants had never been married, while 64.41% had been married at some point. The majority of participants resided in rural areas (64.34%) compared to urban areas (35.66%). In relation to education status, the distribution was as follows: 2.44% had no education, 31.19% had primary education, 58.21% had secondary education, and 8.17% had higher education. Employment status indicated that 73.45% were not working, while 26.55% were employed.

These findings provide a comprehensive overview of the demographic and behavioral characteristics of the study participants, offering insights into the factors that may contribute to Hypertensive Disorders of Pregnancy (HDP) within the three Southern African countries under investigation.

4.1.2 Prevalence of HDP by the socioeconomic, demographic, and behavioral factors

A bivariate analysis was conducted to determine the overall levels of HDP by perinatal behaviors, socioeconomic and demographic characteristics among pregnant women, women who gave birth in the past year, and in the month of the survey (15-49 years old) in the three Southern African countries.

Figure 4. 1: Overall HDP status in South Africa, Lesotho & Namibia



The above figure shows the overall levels of HDP among participants in the sample. Of the total 1273 study participants, 17.36% had HDP, while the majority, 82.64%, did not have HDP.

Figure 4.2: Overall level of HDP for each country

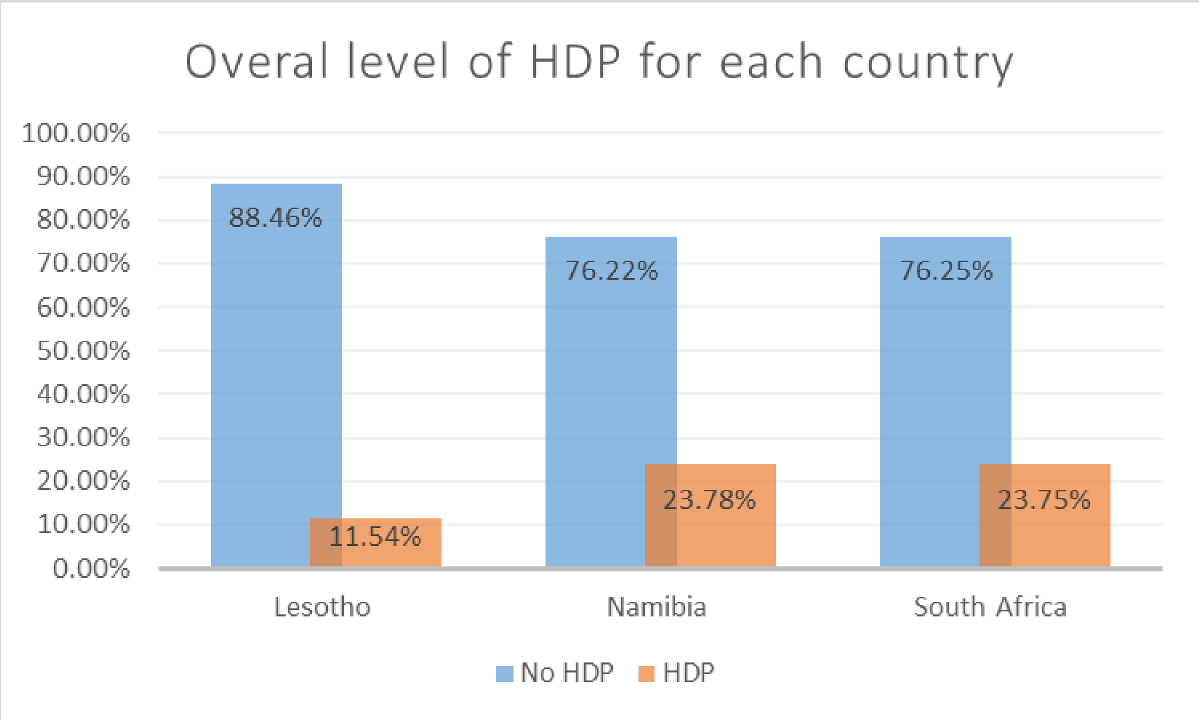


Figure 4.2 shows that the prevalence of HDP is significantly higher in Namibia (23.78%) and South Africa (23.75%), than in Lesotho (11.54%).

Table 4. 2: Levels of HDP in South Africa, Lesotho, and Namibia

Hypertensive Disorders of Pregnancy				
Variables	**No HDP**	**HDP**	**Total**	**P-value**
	n=1052 (82.64)	**n=221 (17.36)**	**N=1273**	
Socio-demographic Characteristics				
Maternal Age n (%)				
15-24	509 (85.26)	88 (14.74)	597	**0.000**
25-34	413 (83.27)	83 (16.73)	496	
35-49	130 (72.20)	50 (27.28)	180	
BMI Category n (%)				

Normal Weight 18.5 to 24.9kg/m2	445 (84.92)	79 (15.08)	524	**0.036**
Overweight 25.0 to 29.9kg/m2	278 (83.48)	55 (16.52)	333	
Obese >30.0kg/m 2	166 (77.57)	48 (22.43)	214	
Marital Status n (%)				
Never married	362 (79.91)	91 (20.09)	453	0.056
Ever Married	690 (84.15)	130 (15.85)	820	
Place residence n (%)				
Rural	710 (86.69)	109 (13.31)	819	**0.000**
Urban	342 (75.33)	112 (24.67)	454	
Parity n (%)				
1-2	755 (85.31)	130 (14.69)	885	**0.001**
3-4	210 (76.36)	65 (23.64)	275	
5+	76 (76.77)	23 (23.23)	99	
Educational Status n (%)				
no education	25 (80.65)	6 (19.35)	31	**0.008**
Primary	346 (87.15)	51 (12.85)	397	
Secondary	604 (81.51)	137 (18.49)	741	
Higher	77 (74.04)	27 (25.96)	104	
Employment Status n (%)				
Not working	769 (82.25)	166 (17.75)	935	0.538
Working	283 (83.73)	55 (16.27)	338	

Iron Supplements Intake n (%)				
No	144 (87.27)	21 (12.73)	165	**0.029**
Yes	669 (80.02)	167 (19.98)	836	
Consumption of Fruits n (%)				
No fruits eaten	219 (74.74)	74 (25.26)	293	0.310
Fruits eaten	224 (78.32)	62 (21.68)	286	
Consumption of vegetables n (%)				
No Veg eaten	156 (75.36)	51 (24.64)	207	0.650
Veg eaten	295 (77.02)	88 (22.98)	383	
Level physical activity n (%)				
Low physical activity	548 (78.74)	148 (21.26)	696	**0.009**
Intense physical activity	117 (88.64)	15 (11.36)	132	
Smoking status n (%)				
Non-Smoker	916 (83.12)	186 (16.88)	1,102	0.163
Smoker	64 (77.11)	19 (22.89)	83	

The table shows that of the primary perinatal behavioral variables selected for this study, levels of physical activity and iron supplement intake are significantly associated with HDP. Remarkably, among participants who reported having bought or given iron supplements when pregnant, about 20% (p=0.029) developed HDP, and a substantial number (21.26%, p=0.009) engaged in low-intensity physical activity during their work and also developed HDP. Additionally, the occurrence of HDP was not associated with marital status, employment status, consumption of fruits and vegetables, and smoking status. In other words, there were statistically insignificant differences in the occurrence of the disease between study participants who were unemployed (17.75%) and employed (16.27%), (25.26%) with no fruits eaten and fruits eaten (21.68%), and 22.98% ate vegetables and 24.64 without eating vegetables, among others.

Table 4.2 above shows that the levels of HDP were significantly associated with age (p=0.000), body mass index (p=0.036), parity (p=0.001), place of residence (p<0.001), educational attainment (p=0.008), iron supplements intake (p=0.029), and level of physical activity (p=0.009) among study participants. Specifically, HDP levels were found to increase with age and were highest among participants aged 36 to 49 (26.8%, p=0.001), obese (22.43%, p=0.001), and urban residents (24.67%, p<0.001). A large proportion of respondents with HDP were those with higher education (25.96%, p=0.008) compared to those without and with a lower level of education. Moreso, the occurrence of HDP was significantly higher among women who had experienced more than two births with relatively equal proportions, whereby 23.64% had about 3 to 4 births and 23.23% gave birth to 5+ children (p=0.001).

Overall, these results provide valuable insights into how various socioeconomic, demographic and behavioral factors are linked to the occurrence of Hypertensive Disorders of Pregnancy within the study population.

4.3: The association between perinatal behaviors and HDP

Table 4. 3: Unadjusted logistic regression estimating independent odds of HDP by selected socioeconomic, demographic, and perinatal behavioral factors

Independent Variable	Odds Ratio	P> |z|	95% Conf. Interval
Iron Supplements Intake			
No	Reference Category		
Yes	1.712	**0.031****	[1.051 -2.789]
Consumption of Fruits			
No fruits eaten	Reference Category		
Fruits eaten	0.819	0.310	[0.557 - 1.204]
Consumption of Vegetables			
No vegetables eaten	Reference Category		
Vegetables eaten	0.912	0.650	[0 .614 - 1.355]
Smoking status			

Non-smoker	Reference Category		
Smoker	1.462	0.165	[0.855 - 2.498]
Occupation types			
Low physical activity	Reference Category		
Intense physical activity	0.474	**0.010****	[0.269 - 0.837]
Country			
Lesotho	Reference Category		
Namibia	2.391	**0.000****	[1.581 - 3.615]
South Africa	2.390	**0.000****	[1.721 - 3.309]
Maternal Age			
15-24	Reference Category		
25-34	1.162	0.367	[0 .838 - 1.612]
35-49	2.224	**0.000****	[1.495 - 3.309]
BMI Category			
Normal Weight	Reference Category		
Overweight	1.114	0.572	[0.765 - 1.622]
Obese	1.629	**0.017****	[1.091 - 2.431]
Marital Status			
Never married	Reference Category		
Ever Married	0.749	**0.050****	[0.557 - 0.880]
Place of residence			
Rural	Reference Category		
Urban	2.133	**0.000****	[1.590 - 2.861]
Parity			
1-2 Births	Reference Category		
3-4 Births	1.798	**0.001****	[1.286 - 2.512]
5+ Births	1.758	**0.028****	[1.064 - 2.904]
Educational Status			
No education	Reference Category		
Primary	0.614	0.309	[0.240 - 1.569]
Secondary	0.945	0.903	[0.380 - 2.348]
Higher	1.461	0.454	[0.541 - 3.943]

Employment Status			
Not working	Reference Category		
Working	0.900	0.538	[0.547 - 1.079]

**Significant p values (<0.05)

Table 4.3 presents the results of the unadjusted model assessing the independent association between selected socioeconomic, demographic, and peri-natal behaviors on HDP. Results show that respondents' age, country of residence, body mass index, marital status, place of residence, parity, iron supplements intake, and physical activity levels are significantly associated with the odds of HDP HDP.

Among the predictor variables with statistically significant results, marital status and physical activity levels emerged as potential protective factors against hypertension disorder (HDP). The study revealed that individuals who had ever been married experienced a 0.75-fold reduction in the odds of HDP ($p<0.05$; 95% confidence interval: 0.486 - 0.880) compared to those who had never been married. Furthermore, there was a notable 0.47-fold decrease in the odds of HDP ($p<0.05$; 95% confidence interval: 0.269 - 0.837) among women engaged in physically intense activities as part of their occupation, in contrast to those in professions that may involve less physical activities. This finding underscores the potential protective effect of physical activity against the development of HDP.

The explanatory variables, smoking, and consuming fruits and vegetables, were found to have p-values of 0.165, 0.310, and 0.485, respectively, indicating that they were not statistically significant predictors of HDP. Despite their lack of statistical significance, there is a suggestive trend in the data that highlights the potential protective effect of consuming fruits and vegetables against HDP. When compared to individuals who reported not consuming fruits or vegetables, those who did reported eating fruits and vegetables had 0.81 times lower odds of HDP (CI: 0.557 - 1.204) and 0.91 times lower odds (CI: 0.576 - 1.299), respectively. Conversely, among the variables, smoking tobacco products was associated with a 1.5-fold increase in the odds of HDP ($p>0.05$; CI: 0.86-2.49) when compared to non-smokers. This finding suggests a potential link between smoking and an elevated risk of HDP.

Concerning the respondents' age, not all age groups were statistically significant. Findings indicate that the odds of HDP is 2.22 times higher among participants aged between 35 to 49 ($p<0.05$; CI:1.49 - 3.31) compared to those in the lower age group (15-24). Regarding body mass index, being obese as opposed to normal weight significantly increased the odds of HDP HDP by 1.63 times ($p<0.05$; CI: 1.091 - 2.43) among pregnant and postpartum women. Similar to older age and obesity, residing in an urban area is associated with an increased risk of hypertension disorder (HDP). Specifically, participants residing in urban areas were 2.13 times higher odds of HDP ($p<0.001$; CI: 1.590 - 2.861) when compared to their rural counterparts.

Furthermore, the number of childbirths also plays a significant role in the odds of HDP hypertension disorder (HDP). Specifically, individuals who have given birth three to four times were 1.98 times more likely to experience HDP ($p=0.001$; CI: 1.286 - 2.512) compared to those who have given birth once or twice. Additionally, those who have given birth more than five times had 1.76 times higher odds of HDP ($p<0.05$; CI: 1.064 - 2.904) in comparison to those with one or two childbirths.

Among the explanatory variables of interest to this study, only iron supplement intake and physical activity levels were statistically significant predictors of HDP. Surprisingly, respondents who reported having been given or bought iron supplements during pregnancy were more likely to reported they had HDP. They had 1.7 times ($p<0.05$; CI:1.051 -2.789) increased odds of HDP compared to those who did not buy or were given iron supplements.

Table 4. 4: Adjusted logistic regression model assessing odds of HDP by perinatal behaviors while controlling for other factors

Independent Variable	Odds Ratio	P value	95% Conf. Interval
Iron Supplements Intake			
No	Reference Category		
Yes	2.990	**0.050****	[0.959 - 9.319]
Consumption of Fruits			
No fruits eaten	Reference Category		
Fruits eaten	1.098	0.756	[0.608 - 1.982]

Consumption of vegetables			
No Veg eaten	Reference Category		
Veg eaten	1.022	0.942	[0.562 - 1.859]
Level of physical activity			
Low physical activity	Reference Category		
Intense physical activity	0.514	0.254	[0.164 - 1.611]
Smoking status			
Non-Smoker	Reference Category		
Smoker	0.807	0.649	[0.321 - 2.028]
Country			
Lesotho	Reference Category		
Namibia	1.246	0.254	[0.890- 2.890]
South Africa	1.303	0.465	[0.639- 2.654]
Maternal Age			
15-25	Reference Category		
26-35	0.758	0.450	[0.370 - 1.554]
36-49	1.738	0.253	[0.673 - 4.486]
BMI Category			
Normal Weight	Reference Category		
Overweight	0.739	0.355	[0.390 - 1.400]
Obese	0.634	0.245	[0.294 - 1.367]
Marital Status			
Never married	Reference Category		
Ever Married	0.754	0.364	[0.410 - 1.387]
Place of residence			
Rural	Reference Category		
Urban	1.558	0.121	[0.889 - 2.731]
Parity			
1-2 Births	Reference Category		
3-4 Births	1.936	0.081	[0.921 - 4.071]

5+ Births	1.073	0.900	[0.354 - 3.246]
Educational Status			
No education	Reference Category		
Primary	0.777	0.790	[0.123 - 4.919]
Secondary	1.218	0.827	[0.207 - 7.155]
Higher	0.521	0.596	[0.0468 - 5.802]
Employment Status			
Not working	Reference Category		
Working	0.984	0.966	[0.481 - 2.013]

**Significant p values (<0.05)

To determine the relationship between perinatal behaviors and HDP, an adjusted logistic regression model was performed by combining all data for all three Southern African countries. After adjusting for socioeconomic and demographic covariates, results from the multivariate analysis indicate that most of the predictor variables selected for this study were not statistically significant as they have p-values greater than 0.05, with the exception of iron supplement intake.

Iron supplement intake was found to have a significant influence on HDP outcomes. Notably, women who reported purchasing or being given iron supplement tablets or syrup during pregnancy had a 2.99 times higher odds of HDP HDP compared to those who did not report such intake (AOR: 2.99; CI: 2.00 to 3.72; p < 0.05).

Furthermore, the study did not find statistically significant differences in the odds of hypertensive disorders of pregnancy (HDP) between individuals who reported consuming vegetables (AOR: 1.022, CI: 0.56 - 1.85, p > 0.05) and those who reported consuming fruits (AOR: 1.098, 95% CI: 0.61 - 1.91, p > 0.05), when compared to individuals who did not consume vegetables and fruits. Despite the absence of statistical significance, it is noteworthy that the consumption of vegetables and fruits was associated with a 1.02-fold and 1.09-fold increase in the odds of HDP, respectively.

No statistically significant difference was observed between HDP and participants' smoking behavior (AOR: 0.81; 95% CI: 0.32 to 2.03; p > 0.05). The results suggest that smokers had reduced odds of HDPodds of HDP HDP compared to non-smokers. Similar to smoking behavior, results show that participants who engaged in physically intense activities in their occupations had lower odds of HDP HDP compared to those involved in professions that may involve less physical activities (AOR: 0.51, CI: 0.16-1.61, p>0.05). Specifically, among women who engaged in physically intense activities in their occupations, the odds of HDP HDP were reduced by a factor of 0.51, indicating a lower risk of HDP when compared to those in professions that may involve less physical activities. However, it's important to note that this result was not statistically significant (p>0.05), suggesting that the observed association may have occurred by chance and is not statistically reliable.

Consequently, the odds of those who reported being smokers and engaged in physically intense activities during their occupations, suggest their protective role against HDP whilst iron supplements intake, consumption of fruits and vegetables suggest increased the risk of HDP. That is, there is potential that the odds of HDP HDP were much lower for smokers and those in physically demanding occupations.

4.4 Test for Multicollinearity

To establish whether multi-collinearity existed between the predictor variables selected for this investigation, correlation coefficients were computed using the pwcorr command. Table 5.1 in the Appendix 1 shows that most variables show correlation coefficients below 65%, indicating that the predictor variables were not significantly related.

Chapter 5: Discussion

This study aimed to investigate the relationship between selected perinatal behaviors and Hypertensive Disorders of Pregnancy (HDP), and determine the prevalence of HDP in the three Southern African countries. The primary finding of this research showed that of the five perinatal behavior variables investigated in this study, only iron supplement intake was significantly associated with HDP. As previously mentioned, there are inconsistencies in literature on the impact of these perinatal behaviors on HDP with some studies finding no significant associations, while other show inconclusive results on the association of these perinatal behaviors to HDP (Meazaw et al., 2020a; Schoenaker et al., 2014).

It's noteworthy that the prevalence of HDP was significantly higher ($p<0.0001$) in the Southern African countries with an upper middle-income status namely South Africa (23.75%) and Namibia (23.78%) than in Lesotho (11.54%) with lower-middle-income status. This finding is consistent with a research by Noubiap, (2019), who postulates that a country's income level may contribute to increased prevalence of HDP. We propose this positive correlation between a country's income level and increased prevalence of HDP is attributed to high urban populations observed in Namibia and South Africa. When compared to other developing countries of the same income level status in the Sub-Saharan African region, both South Africa and Namibia had relatively the same prevalence as Botswana (22.2%) (Johnson et al., 2016).

As previously reiterated, urbanization in Sub-Saharan African region is positively correlated with nutrition transition which results in high prevalence of non-communicable diseases (Nnyepi et al., 2015; Unwin et al., 1999). For instance, Sani et al. (2022) suggested that uncontrolled urbanization in West Africa could lead to hypertension, heart diseases, and mental health problems due to sedentary, unhealthy lifestyles involving poor diet, alcohol, and smoking. This finding is interesting as it is observed in populations that have better income, access to better health care facilities and antenatal care services as well as having better awareness due to access to information and education. Therefore, it is evident that countries like South Africa and Namibia remain at high risk of experiencing HDP and warrants better policies and awareness programmes to mitigate this risk and lower the prevalence of HDP.

The results from this study aligns with studies that show no significant association between perinatal behaviors and HDP. However, the significant association of iron supplement intake with HDP observed in this study collaborates the findings by Bo et al. (2009) in Italy, who found iron supplementation to be significantly associated with hypertension in mid-pregnancy with a two to three fold increased risk on women that took these supplements. Similarly, for this study, women who reported taking iron supplements had a three fold increased risk of having HDP compared to those who did not. To the best of the authors knowledge, this study is the first to report an association between iron supplement intake and HDP in Southern Africa. Similar studies in East Africa by Asres et al (2023) showed no significant differences in association between iron-folic acid supplementation and pregnancy-induced hypertension among pregnant women. However, it must be noted that the study by Asres et al. (2023) was conducted in one province in Ethiopia at a health facility, while this study was conducted on three Southern African countries. Noteworthy is the fact the observation from this study could have been influenced by a bigger sample size (n=1273) compared to the Ethiopian study which had only 447 participants. As such this study could potentially provide a more robust statistical analysis as it had a bigger sample size and was conducted utilizing a population based dataset which gives a better representation of the study population.

It is important to comment that while studies have documented the benefits of antenatal iron supplements in reducing premature births, low birth weight, and general maternal health among non-anemic pregnant women, there has been growing evidence of it being linked to gestational diabetes and hypertension during pregnancy (Mwangi, Prentice, and Verhoef, 2017; Palma et al., 2008; Bo et al.,2009; Falahi et al., 2011; Jirakittidul et al., 2018; Ziaei et al., 2007).

Although the majority of the perinatal behaviors from this study showed no significant association with HDP, our data showed that 17.36% of women from South Africa, Lesotho and Namibia, had HDP while 82.64% did not. The percentage of women with HDP in this study indicate that it is double the global range of between 5% and 10% while being slightly above the African range of 8% to 10% (Say et al., 2014; Umesawa & Kabashi, 2017; WHO, 2018; Noubiap, 2019; Gemechu et al., 2020). This high prevalence of HDP observed in this study may indicate a higher risk among pregnant women in these three Southern African countries. Further studies using bigger sample sizes and more stringent statistical tools may need to be conducted to further understand this risk and device ways to lower this risk to acceptable global averages or even lower. However, it should be noted that the inclusion criteria of participants for this study consisted both pregnant and postpartum women who had given birth for up to one year before the survey. This could have overstated the prevalence of HDP. Nonetheless, the inclusion criteria for this study was informed by the growing evidence that pregnancy-induced hypertension could persist up to a year after pregnancy (Nakimuli et al., 2013; Nganou-

Gnindjio et al., 2021; Ishaku et al., 2021; Giorgione et al., 2020). Additionally, previous studies in the region have mainly been facility-based and focused on urban settings, potentially underestimating the true prevalence of HDP in Southern Africa.

The rationale for selecting the three of Southern African countries namely, Lesotho, Namibia, and South Africa for this study stemmed from several key considerations. Firstly, the absence of comprehensive blood pressure measurement data for the study population in most Southern African countries from the Demographic Health Survey dataset necessitated this approach. Secondly, the geographical proximity of these nations facilitated their inclusion, allowing for a more concentrated examination of the region. Lastly, the dearth of relevant information in Southern African studies investigating the correlation between perinatal behaviors (specifically smoking, physical activity, iron supplementation, and fruit and vegetable consumption) and hypertensive disorders of pregnancy underscored the importance of focusing on this region.

This study found no significant association between smoking with HDP, even though the results potentially suggest its protective effect against HDP while controlling for other variables. Mothers who reported that they smoked during pregnancy had a reduced risk of HDP compared to non-smokers. These finding are consistent with studies that have found smoking during pregnancy to be protective against HDP. For example, Canadian case-control research indicated that compared to nonsmokers, women who smoked during the outset of their pregnancy had a relatively low risk of pre-eclampsia and that the protective impact of smoking was significant among women who kept smoking after 20 weeks of gestation (Marcoux, Brisson & Fabia, 1989). In another case-control study conducted in Germany, smoking reduced the incidence of HDP by 56%. (Leeners et al., 2006). On the contrary, these results conflict with some recent studies that found that women who smoked tobacco and other smokeless tobacco products had an increased risk of HDP while controlling for other variables (Sharma et al., 2022).

However, one significant factor to consider is the cultural acceptance of smoking among women in different regions. In many Southern African countries, smoking among women is not culturally acceptable, which may lead to underreporting of smoking habits among pregnant women participating in this study. This underreporting could have contributed to the observed lack of significant results, as pregnant women might have been hesitant to disclose their smoking habits due to the fear of social stigma. In contrast, in countries like Canada and India, smoking in general or the use of smokeless tobacco with betel quid is more socially acceptable

(Marcoux, Brisson & Fabia, 1989; Sharma et al., 2022), which could explain the differing prevalence of smoking among pregnant women and its associated risk for HDP in these regions. Given the inconclusive evidence on the protective effects of smoking on pregnant and postpartum women on HDP, targeted anti-smoking campaigns should be culturally sensitive and tailored to manage the different contexts in the three Southern African countries.

The study's findings generally suggested that women who engaged in physically intense occupations were at reduced risk of HDP, albeit insignificant results. This means that women who reported to be involved in agriculture work, skilled and unskilled manual labour as their occupations had lowered odds of HDP compared to those who fell within professional, technical, managerial, clerical, household/domestic, and service-related occupations. This study's findings suggest a protective effect of intense physical activity align with numerous studies conducted on HDP in Africa and various European countries (Covet et al., 2018; Davenport et al., 2018; Kasawara et al., 2012; Spracklen et al., 2016). These studies consistently demonstrate reduced odds of experiencing HDP and overall improvement in maternal health for women engaged in moderate to intense physical activities—whether in leisure, occupational settings, or otherwise at different stages of pregnancy. This study extends findings made by other researchers and raises the possibility that increased physical activity levels in occupations may be beneficial to improving pregnancy health in general and, more specifically, reducing the risk of developing HDP in Southern Africa. It means that special attention need to be given to pregnant women who are in professions that may involve less physical activities and encourage them to engage in moderate physical activities.

Notably, the findings of this investigation revealed relatively low levels of physical activity, indicating that only 11% of women may be involved in physically intense activities in their occupations. Despite scant information on physical activity levels of pregnant women in Southern Africa, this research is similar with results from earlier African studies in that it found very low levels of physical activity during pregnancy (Lawan et al.,2018). For instance, a recent facility-based survey in South Africa reported that only 25.7% of women engaged in moderate-intensity exercise per week, while a study in Nigeria had only 14.6% of pregnant women who had achieved the required level of physical activity (Lawan et al.,2018; Okafor &Goon, 2020). According to Catov et al. (2018), women with low leisure time-physical activity had higher levels of HDP than those following high physical activity patterns.

Some of the reasons that could explain the relatively very low levels of physical activity in this study include, in part, the method used to assess physical activity, which only considered physical activity based on participants' occupations. Hence this criterion excluded other forms and types of activities, namely leisure physical activity, walking, and running. Moreso, given the use of occupation type as a measure of physical activity among pregnant women, high levels of unemployment among the participants might also explain the low levels of physical activity. Equally essential is the idea that lower age, as opposed to older age, explains very low levels of physical activity during pregnancy for this study. That has also been found as one of the factors significantly associated with low levels of physical activity in some studies (Catov et al., 2018; Okafor & Goon, 2020a). Important note for this study, about 73.5% of study participants were unemployed.

In the multivariate analysis of the impact consumption of fruits and vegetables had on HDP, the odds ratio results from this study indicated that mothers who included fruits and vegetables in their diet were at increased risk of HDP, albeit not statistically significant. This finding is consistent with previous studies that have found the intake of fruits and vegetables among pregnant women increase the odds of HDP (Dodd et al., 2014; Kinshella et al., 2021; Miller et al., 2022; Schoenaker et al., 2014; Tesfa et al., 2020; O'Brien, & Grivell, 2014). Similarly, the findings of a number of studies found no statistical relationship between fruit and vegetable consumption and HDP (Eshriqui et al., 2016; Fulay et al. 2018; Timmermans et al., 2011). Interestingly some studies found that consuming a diet high in fruits and vegetables is most beneficial in improving pregnancy outcomes among women with HDP and preventing the progression of gestational hypertension to a severe form of HDP pre-eclampsia (Jiang et al., 2019; Sower et al., 2022). For instance, a study in Ghana revealed that intake of large quantities of fruits and vegetables decreased the odds of low birth weight and preterm births among women with HDP (Sower et al., 2022). One possible explanation for statistically insignificant results in this investigation could be that the physiological effect of fruits and vegetables were masked by the failure to account for the impact of other food items. That includes sugar-sweetened beverages, processed meats, high-fat dairy products, and salty snacks. Moreso, there were a number of missing observations for these key variables.

The conceptual framework of this study was built on the assumption that smoking behavior, physical activity, routine iron supplementation, consumption of fruits and vegetables in Southern African countries might have unintended consequences on HDP. The study's findings on routine iron supplementation aligned with this conceptual framework. While the other variables namely smoking, physical activity, consumption of fruits and vegetables are generally not supporting this study's conceptual framework when considering the insignificant p value.

5.6 Results of Hypothesis testing

The research hypothesized a statistically significant relationship between perinatal behaviors and HDP. In other words, the study assumed that perinatal behaviors, namely smoking, physical activity, iron supplement intake, and consumption of fruits and vegetables, are either protective against or increased the risk of HDP. Given that there was a significant relationship between one selected perinatal behaviors and HDP, namely iron supplement intake, the researcher rejects the null hypothesis. Specifically, the research found that pregnant and postpartum women who bought or were given iron supplement tablets had an increased odds of HDP.

Chapter 6: Conclusion & Recommendations

6.1 Conclusion

In conclusion, the findings of this study provide valuable insights into the occurrence of Hypertensive Disorders of Pregnancy in the three Southern Africa countries. To the researchers knowledge, this study could potentially be one of the first to report the negative impact of iron supplement intake on HDP in Southern Africa. Given that most Southern African countries including Lesotho, South Africa and Namibia prescribe iron supplements to all pregnant women as part of antenatal care recommendations (Department of Health, 2015; Goodchild, 2018; Ba et al., 2019), the author recommendations that iron supplements prescriptions should be based on the pregnant woman's iron status rather than being made mandatory. This is important in the context that both this study and previous research demonstrate an elevated risk of HDP among healthy pregnant women, and the potential benefits for anemic pregnant women.

The investigation affirms the high prevalence of HDP in the three SACs, particularly in countries of upper middle-income status as observed in Namibia and South Africa. This emphasizes the significance of targeted public health policies and intervention programs that concentrate on fostering lifestyle modifications to enhance urban nutrition patterns, mitigate obesity, and subsequently alleviate the burden of HDP.

Furthermore, the study underscores the continued effectiveness of intense physical activity as a preventive strategy for managing and reducing the risks associated with HDP among both pregnant and postpartum women. Conversely, unlike certain studies that have highlighted the potential benefits of fruit and vegetable consumption in lowering HDP risks, this study found contrary evidence to support such an effect.

6.2 Research & Policy Recommendations

Research Recommendations

Considering the insignificant evidence on the effects of a diet high in fruits and vegetables among pregnant and postpartum women. Future studies should consider adopting prospective interventional methodology to assess the impact of a comprehensive dietary pattern with all essential food items on HDP, the frequency of consumption, and the types of fruits and vegetables consumed in Southern Africa. Additionally, the effect of diets rich in fruits and vegetables on HDP should be studied while considering the nutrient intake of pregnant and postpartum women. Some of the nutritional components to account for would include zinc, calcium, Vitamin C, and D. Consequently, research on the influence of a vitamin supplement-based diet and overall dietary patterns on HDP will enlighten and contribute to the development of relevant dietary guidelines for pregnant and postpartum women in Southern Africa.

Also given the data limitation that could not allow country analysis of the perinatal behaviors and HDP, future research should consider conducting specific country analysis assessments utilizing population based surveys.

Policy Recommendations

At a policy level, considering that most Southern African countries prescribe a daily dose of iron supplements to all pregnant women, even though many of them are iron-sufficient and the occurrence of anemia is relatively low. Relevant nutritional guidelines for pregnant and postpartum women in the Southern African context are recommended. One such policy based on this study would be to promote the transition from the standard administering of iron tablets to all pregnant women to prescribing these tablets based on a pregnant women's iron status. Moreso, considering that occupation types can determine the risk of HDP, whereby those mothers involved in professions that may involve less physical activities are more likely to develop HDP. HDP management guidelines should consider adopting occupation types when screening and assessing pregnant and postpartum women during antenatal and postnatal care visits to identify mothers at risk of HDP. Similarly, mothers' smoking status should be adopted during screening and assessment for HDP risk factors and be targeted as part of the counseling and advocacy efforts to prevent HDP.

6.3 Strengths and Limitations of the Study

One of the most key values of this study is that to the best of the researcher’s knowledge, this could potentially be one of the first studies in Southern Africa to 1. examine the relationship of perinatal behaviors against HDP among both pregnant and postpartum women. 2. as well as determine the prevalence of the disease utilizing a standardized population-based survey that considers both rural and urban settings and participants outside a hospital setting. Hence, the putative protective and risk factors identified by this study could potentially begin to influence practical interventions regarding HDP prevention and management methods at a regional level.

A few limitations of this study should also be recognized. Apart from the challenges implicit in the cross-sectional study design, such as the inability to make causal inferences, this study faced a couple of issues outlined below. There was a substantial number of missing observations for key variables of interest for this study, with the major affected variables being the consumption of fruits and vegetables. Thereby impeding any prospects of conducting separate country analyses that are key to make room for country-specific policy recommendations. There were also challenges with incomplete blood pressure measurements for this study's interest group, which significantly reduced the study population size. As a result, conducting a comparative analysis between countries was difficult, as initially proposed.

References

Abalos, E., Cuesta, C., Grosso, A. L., Chou, D., & Say, L. (2013). Global and Regional Estimates of Preeclampsia and Eclampsia: A Systematic Review. European Journal of Obstetrics & Gynecology and Reproductive Biology, 170(1), 1–7. https://doi.org/10.1016/j.ejogrb.2013.05.005

Abel, M. H., Caspersen, I. H., Sengpiel, V., Jacobsson, B., Meltzer, H. M., Magnus, P., ... & Brantsæter, A. L. (2020). Insufficient maternal iodine intake is associated with subfecundity, reduced foetal growth, and adverse pregnancy outcomes in the Norwegian Mother, Father, and Child Cohort Study. BMC medicine, 18(1), 1-17.

Agbo, H., Okeahialam, B., & Daru, P. (2016). Obstetric predictors of hypertension: A cross-sectional study of women attending the postnatal clinic of Jos University Teaching Hospital. Nigerian Medical Journal, 57(6), 320. https://doi.org/10.4103/0300-1652.193856

Ali, A. A., Rayis, D. A., Abdallah, T. M., Elbashir, M. I., & Adam, I. (2011). Severe Anaemia Is Associated with a Higher Risk for Preeclampsia and Poor Perinatal Outcomes in Kassala Hospital, Eastern Sudan. BMC Research Notes, 4(1), 311. https://doi.org/10.1186/1756-0500-4-311

Arvizu, M., Bjerregaard, A. A., Madsen, M. T., Granström, C., Halldorsson, T. I., Olsen, S. F., & Chavarro, J. E. (2020). Sodium intake during pregnancy, but not other diet recommendations aimed at preventing cardiovascular disease, is positively related to the risk of hypertensive disorders of pregnancy. The Journal of nutrition, 150(1), 159-166.

Arroyo-Helguera, O., García-Solís, P., Navarro-Meza, M., Cuellar-Rufino, S., & Xochihua-Rosas, I. (2017). Iodine levels are associated with oxidative stress and antioxidant status in pregnant women with hypertensive disease. Nutricion Hospitalaria, 34(3), 661-666.

Atkinson, J., Mahomed, K., Williams, M., Woelk, G., Mudzamiri, S., & Weiss, N. (1998). Dietary Risk Factors for Pre-Eclampsia Among Women Attending Harare Maternity Hospital, Zimbabwe. Cent Afr J Med, 44(4), 86–92. PubMed.

Ayala, D. E., & Hermida, R. C. (2001). Influence of parity and age on ambulatory monitored blood pressure during pregnancy. Hypertension, 38(3), 753-758.

Ayogu, M. E., Akaba, G. O., Offiong, R. A., Adewole, N. D., & Ekele, B. A. (2020). Risk factors for hypertensive disorders of pregnancy in Abuja, Nigeria: A prospective case-control study. Tropical Journal of Obstetrics and Gynaecology, 37(1), 46-52.

Azubuike, S., & Danjuma, I. (2017). Hypertension in pregnancy among rural women in Katsina State, Nigeria. Journal of Basic and Clinical Reproductive Sciences, 6(1).

Azuh, D., Fayomi, O., & Ajayi, L. (2015). Socio-cultural factors of gender roles in women's healthcare utilization in Southwest Nigeria. Open Journal of Social Sciences, 3(04), 105.

Ba, D. M., Ssentongo, P., Kjerulff, K. H., Na, M., Liu, G., Gao, X., & Du, P. (2019). Adherence to iron supplementation in 22 sub-Saharan African countries and associated factors among pregnant women: a large population-based study. Current developments in nutrition, 3(12), nzz120.

Ban, L., Gibson, J. E., West, J., Fiaschi, L., Oates, M. R., & Tata, L. J. (2012). Impact of socioeconomic deprivation on maternal perinatal mental illnesses presenting to UK general practice. British Journal of General Practice, 62(603), e671-e678.

Benschop, L., Duvekot, J. J., & Roeters van Lennep, J. E. (2019). Future risk of cardiovascular disease risk factors and events in women after a hypertensive disorder of pregnancy. Heart (British Cardiac Society), 105(16), 1273–1278. https://doi.org/10.1136/heartjnl-2018-313453

Berhe, A. K., Kassa, G. M., Fekadu, G. A., & Muche, A. A. (2018). Prevalence of hypertensive disorders of pregnancy in Ethiopia: a systemic review and meta-analysis. BMC pregnancy and childbirth, 18(1), 1-11.

Bilano, V. L., Ota, E., Ganchimeg, T., Mori, R., & Souza, J. P. (2014). Risk factors of pre-eclampsia/eclampsia and its adverse outcomes in low-and middle-income countries: a WHO secondary analysis. PloS one, 9(3), e91198.

Bilhartz, T. D., & Bilhartz, P. (2013). Occupation as a risk factor for hypertensive disorders of pregnancy. Journal of Women's Health, 22(2), 188a-188i.

Bo, S., Menato, G., Villois, P., Gambino, R., Cassader, M., Cotrino, I., & Cavallo-Perin, P. (2009). Iron supplementation and gestational diabetes in mid-pregnancy. American journal of obstetrics and gynecology, 201(2), 158-e1.

Brown, M. A., Magee, L. A., Kenny, L. C., Karumanchi, S. A., McCarthy, F. P., Saito, S., & Ishaku, S. (2018). Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. Hypertension, 72(1), 24-43.

Catov, J. M., Parker, C. B., Gibbs, B. B., Bann, C. M., Carper, B., Silver, R. M., ... & Grobman, W. A. (2018). Patterns of leisure-time physical activity across pregnancy and adverse pregnancy outcomes. International Journal of Behavioral Nutrition and Physical Activity, 15(1), 1-10.

Chang, P. J., Chu, L. C., Hsieh, W. S., Chuang, Y. L., Lin, S. J., & Chen, P. C. (2010). Working hours and risk of gestational hypertension and pre-eclampsia. Occupational medicine, 60(1), 66-71.

Christians, F. (2020). Country profile—Primary healthcare and family medicine in Namibia. African Journal of Primary Health Care & Family Medicine, 12(1), 1-3.

Chittacharoen, A., Wetchapruekpitak, S., & Suthutvoravut, S. (2005). Pregnancy-induced hypertension in twin pregnancy—Journal-Medical Association of Thailand, 88, S69.

Davenport, M. H., Ruchat, S.-M., Poitras, V. J., Jaramillo Garcia, A., Gray, C. E., Barrowman, N., Skow, R. J., Meah, V. L., Riske, L., Sobierajski, F., James, M., Kathol, A. J., Nuspl, M., Marchand, A.-A., Nagpal, T. S., Slater, L. G., Weeks, A., Adamo, K. B., Davies, G. A., Mottola, M. F. (2018). Prenatal Exercise for the Prevention of Gestational Diabetes Mellitus and Hypertensive Disorders of Pregnancy: A Systematic Review and Meta-Analysis. British Journal of Sports Medicine, 52(21), 1367–1375. https://doi.org/10.1136/bjsports-2018-099355

Dawonauth, L., Jeeawoody, R. B., Jankee, S., & L'Omelette, A. D. (2019). High rate of early onset preeclampsia in Mauritius. Journal of Reproductive Immunology, 136, 102611.

Duberstein, Z. T., Brunner, J., Panisch, L. S., Bandyopadhyay, S., Irvine, C., Macri, J. A., ... & O'Connor, T. G. (2021). The biopsychosocial model and perinatal health care: determinants of perinatal care in a community sample. Frontiers in psychiatry, 12, 746803.

Drago, F., Scharf, R. J., Maphula, A., Nyathi, E., Mahopo, T. C., Svensen, E., ... & Rogawski McQuade, E. T. (2020). Psychosocial and environmental determinants of child cognitive development in rural south africa and tanzania: Findings from the mal-ed cohort. BMC public health, 20(1), 1-8.

Dodd, J. M., O'Brien, C., & Grivell, R. M. (2014). Preventing pre-eclampsia-are dietary factors the key?. BMC Medicine, 12(1), 1-3.

England, L., & Zhang, J. (2007). Smoking and risk of pre-eclampsia: a systematic review. Frontiers in Bioscience-Landmark, 12(7), 2471-2483.

Eiríksdóttir, V. H., Valdimarsdóttir, U. A., Ásgeirsdóttir, T. L., Hauksdóttir, A., Lund, S. H., Bjarnadóttir, R. I., ... & Zoëga, H. (2015). Pregnancy-induced hypertensive disorders before and after a national economic collapse: a population-based cohort study. PloS one, 10(9), e0138534.

Eshriqui, I., Vilela, A. A. F., Rebelo, F., Farias, D. R., Castro, M. B. T., & Kac, G. (2016). Gestational dietary patterns are not associated with blood pressure changes during pregnancy and early postpartum in a Brazilian prospective cohort. European journal of nutrition, 55(1), 21-32.

Falahi, E., Akbari, S., Ebrahimzade, F., & Gargari, B. P. (2011). Impact of prophylactic iron supplementation in healthy pregnant women on maternal iron status and birth outcome. Food and nutrition bulletin, 32(3), 213-217.

Fulay, A. P., Rifas-Shiman, S. L., Oken, E., & Perng, W. (2018). Associations of the dietary approaches to stop hypertension (DASH) diet with pregnancy complications in Project Viva. European Journal of clinical nutrition, 72(10), 1385-1395.

Fondjo, L. A., Amoah, B., Tashie, W., & Annan, J. J. (2022). Risk factors for the development of new-onset and persistent postpartum preeclampsia: A case-control study in Ghana. Women's Health, 18, 17455057221109362.

Gebremedhin, S. (2018). Development of a new model for estimating maternal mortality ratio at national and sub-national levels and its application for describing sub-national variations of maternal death in Ethiopia. Plos one, 13(8), e0201990.

Gemechu, K. S., Assefa, N., & Mengistie, B. (2020). Prevalence of Hypertensive Disorders of Pregnancy and Pregnancy Outcomes in Sub-Saharan Africa: A Systematic Review and Meta-Analysis.Women'sHealth,16, 174550652097310. https://doi.org/10.1177/1745506520973105

Giorgione, V., Ridder, A., Kalafat, E., Khalil, A., & Thilaganathan, B. (2021). Incidence of postpartum hypertension within two years of a pregnancy complicated by pre-eclampsia: a systematic review and meta-analysis. BJOG: An International Journal of Obstetrics & Gynaecology, 128(3), 495-503.

Goodchild, C. (2018). Iron status in relation to morbidity when considering iron supplementation among urban pregnant women in South Africa (Doctoral dissertation, North-West University).

Goodman, J. H. (2019). Perinatal depression and infant mental health. Archives of psychiatric nursing, 33(3), 217-224.

Hernández-Díaz, S., Toh, S., & Cnattingius, S. (2010). Risk of pre-eclampsia in first and subsequent pregnancies: prospective cohort study. Obstetric Anesthesia Digest, 30(2), 98-99.

Higgins, J. R., Walshe, J. J., Conroy, R. M., & Darling, M. R. N. (2002). The relation between maternal work, ambulatory blood pressure, and pregnancy hypertension. Journal of Epidemiology & Community Health, 56(5), 389-393.

Hinkosa, L., Tamene, A., & Gebeyehu, N. (2020). Risk Factors Associated with Hypertensive Disorders in Pregnancy in Nekemte Referral Hospital, from July 2015 to June 2017, Ethiopia: Case-Control Study. BMC Pregnancy and Childbirth, 20(1), 1–9.

Hofmeyr, G. J., Lawrie, T. A., Atallah, Á. N., & Torloni, M. R. (2018). Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Cochrane database of systematic reviews, (10).

Ishaku, S. M., Jamilu, T., Innocent, A. P., Gbenga, K. A., Lamaran, D., Lawal, O., & Browne, J. L. (2021). Persistent Hypertension Up to One Year Postpartum among Women with Hypertensive Disorders in Pregnancy in a Low-Resource Setting: A Prospective Cohort Study. Global heart, 16(1).

Jiang, F., Li, Y., Xu, P., Li, J., Chen, X., Yu, H., ... & Chen, W. (2019). The efficacy of the Dietary Approaches to Stop Hypertension diet with respect to improving pregnancy outcomes in women with hypertensive disorders. Journal of Human Nutrition and Dietetics, 32(6), 713-718.

Jirakittidul, P., Sirichotiyakul, S., Ruengorn, C., Techatraisak, K., & Wiriyasirivaj, B. (2018). Effect of iron supplementation during early pregnancy on the development of gestational hypertension and pre-eclampsia. Archives of gynecology and obstetrics, 298(3), 545-550.

Johnson, K. M., Zash, R., Haviland, M. J., Hacker, M. R., Luckett, R., Diseko, M., ... & Shapiro, R. (2016). Hypertensive disease in pregnancy in Botswana: prevalence and impact on perinatal outcomes. Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health, 6(4), 418-422.

Kahsay, H. B., Gashe, F. E., & Ayele, W. M. (2018). Risk factors for hypertensive disorders of pregnancy among mothers in Tigray region, Ethiopia: Matched case-control study. BMC Pregnancy and Childbirth, 18(1), 1–10.

Kasawara, K. T., Nascimento, S. L. D., Costa, M. L., Surita, F. G., & e Silva, J. L. P. (2012). Exercise and physical activity in the prevention of pre-eclampsia: a systematic review. Acta obstetricia et Gynecologica Scandinavica, 91(10), 1147-1157.

Khan, K. S., Wojdyla, D., Say, L., Gülmezoglu, A. M., & Van Look, P. F. (2006). WHO Analysis of Causes of Maternal Death: A Systematic Review. The Lancet, 367(9516), 1066–1074. https://doi.org/10.1016/S0140-6736(06)68397-9

Kibret, K. T., Chojenta, C., D'Arcy, E., & Loxton, D. (2020). The Effect of Dietary Patterns on Hypertensive Disorders of Pregnancy in North Shewa, Ethiopia: A Propensity Score Matched Case-control study. Pregnancy Hypertension,22,24–29. https://doi.org/10.1016/j.preghy.2020.07.002

Kibret, K. T., Chojenta, C., Gresham, E., Tegegne, T. K., & Loxton, D. (2018). Maternal Dietary Patterns and Risk of Adverse Pregnancy (hypertensive Disorders of Pregnancy and Gestational Diabetes Mellitus) and Birth (Preterm Birth and Low Birth Weight) Outcomes: A Systematic Review and Meta-Analysis. Public Health Nutrition, 22(3), 506–520. https://doi.org/10.1017/S1368980018002616

Kinshella, M.-L. W., Omar, S., Scherbinsky, K., Vidler, M., Magee, L. A., von Dadelszen, P., Moore, S. E., & Elango, R. (2021). Maternal Dietary Patterns and Pregnancy Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Advances in Nutrition, 12(6), 2387–2400. https://doi.org/10.1093/advances/nmab057

Klonoff-Cohen, H. S., Cross, J. L., & Pieper, C. F. (1996). Job stress and preeclampsia. Epidemiology, 245-249.

Larry, J., Wisdom, T., Wisdom, K. A., Richard, O., Phyllis, A., & Elvis, T. (2017). Risk factors associated with pregnancy-induced hypertension in the Hohoe Municipality of Ghana. J Prev Med Health, 1(3), 1011.

Landsbergis, P. A., & Hatch, M. C. (1996). Psychosocial work stress and pregnancy-induced hypertension. Epidemiology, 7(4), 346-351.

Lawan, A., Awotidebe, A. W., Oyeyemi, A. L., Rufa, A. A., & Oyeyemi, A. Y. (2018). Relationship between physical activity and health-related quality of life among pregnant women. African Journal of Reproductive Health, 22(3), 80-89.

Leeners, B., Neumaier-Wagner, P., Kuse, S., & Rath, W. (2006). Smoking and the risk of developing hypertensive diseases in pregnancy: what is the effect on HELLP syndrome? Acta obstetricia et gynecologica Scandinavica, 85(10), 1217-1224.

Lesotho Food and Nutrition Coordinating Office. (2016). Lesotho Food and Nutrition Policy (LFNP) 2016 – 2025. Maseru.

Longo-Mbenza, B., Tshimanga, B., Buassa-bu-Tsumbu, B., & Kabangu, J. (2008). Diets Rich in Vegetables and Physical Activity Are Associated with a Decreased Risk of Pregnancy Induced Hypertension Among Rural Women from Kimpese, Dr. Congo. Nigerian Journal of Medicine, 17(3). https://doi.org/10.4314/njm.v17i3.37393

Lykke, J. A., Langhoff-Roos, J., Sibai, B. M., Funai, E. F., Triche, E. W., & Paidas, M. J. (2009). Hypertensive pregnancy disorders, subsequent cardiovascular morbidity, and type 2 diabetes mellitus in the mother. Hypertension, 53(6), 944-951.

Magee, L. A., Brown, M. A., Hall, D. R., Gupte, S., Hennessy, A., Karumanchi, S. A., Kenny, L. C., McCarthy, F., Myers, J., Poon, L. C., Rana, S., Saito, S., Staff, A. C., Tsigas, E., & von Dadelszen, P. (2022). The 2021 International Society for the Study of Hypertension in Pregnancy Classification, Diagnosis & Management Recommendations for International Practice.Pregnancy Hypertension, 27, 148–169. https://doi.org/10.1016/j.preghy.2021.09.008

Marcoux, S., Brisson, J., & Fabia, J. (1989). The effect of cigarette smoking on the risk of preeclampsia and gestational hypertension. American journal of epidemiology, 130(5), 950-957.

Mbouemboue, O. P., Cellou, D., Tamanji, M. T., Blakga, C., Kamdje, A. H. N., Ngoufack, J. O., & Youmbi, A. (2016). A study on factors related to hypertensive disorders in pregnancy in Ngaoundere (Adamawa Region, Cameroon). Clinical Medicine Research, 5(2), 6-12.

McCarthy, J., & Maine, D. (1992). A framework for analyzing the determinants of maternal mortality. Studies in family planning, 23(1), 23-33.

Meazaw, M. W., Chojenta, C., Muluneh, M. D., & Loxton, D. (2020a). Factors Associated with Hypertensive Disorders of Pregnancy in Sub-Saharan Africa: A Systematic and Meta-Analysis. PLOS ONE, 15(8), e0237476. https://doi.org/10.1371/journal.pone.0237476

Meazaw, M. W., Chojenta, C., Muluneh, M. D., & Loxton, D. (2020b). Factors associated with hypertensive disorders of pregnancy in sub-Saharan Africa: A systematic and meta-analysis. PLOS ONE, 15(8), e0237476. https://doi.org/10.1371/journal.pone.0237476

Mekonen, L., Shiferaw, Z., Wubshet, E., & Haile, S. (2018). Pregnancy Induced Hypertension and Associated Factors among Pregnant Women in Karamara Hospital, Jijiga, Eastern Ethiopia, 2015. Journal of Pregnancy and Child Health, 5(3), 1-4.

Miller, C., Boushey, C., Benny, P., Ma, S., Huang, J., Lim, E., & Lee, M. J. (2022). Diet quality predicts hypertensive disorders of pregnancy in Asian and Pacific Islander Cohort. Nutrition and Health, 02601060221109668.

Moodley, J., Soma-Pillay, P., Buchmann, E., & Pattinson, R. C. (2019). Hypertensive disorders in pregnancy: 2019 National guideline. South African Medical Journal, 109(9).

Moodley, J., Onyangunga, O. A., & Maharaj, N. R. (2016). Hypertensive disorders in primigravid black South African women: a one-year descriptive analysis. Hypertension in pregnancy, 35(4), 529-535.

Muti, M., Tshimanga, M., Notion, G. T., Bangure, D., & Chonzi, P. (2015). Prevalence of Pregnancy Induced Hypertension and Pregnancy Outcomes Among Women Seeking Maternity Services in Harare, Zimbabwe. BMC Cardiovascular Disorders, 15(1), 111. https://doi.org/10.1186/s12872-015-0110-5

Mwanri, A. W., Kinabo, J. L., Ramaiya, K., & Feskens, E. J. M. (2015). High Blood Pressure and Associated Risk Factors Among Women Attending Antenatal Clinics in Tanzania. Journal of Hypertension, 33(5), 940–947. https://doi.org/10.1097/HJH.0000000000000501

Nakimuli, A., Elliott, A. M., Kaleebu, P., Moffett, A., & Mirembe, F. (2013). Hypertension persisting after pre-eclampsia: a prospective cohort study at Mulago Hospital, Uganda. PloS one, 8(12), e85273.

Namibia Ministry of Health and Social Services. (2014). Report of the Prevalence and Contributing Factors of Facility-Based Maternal and Neonatal Deaths in Five Regions of Namibia (Erongo, Hardap, //Karas, Khomas, Omaheke) during 2010–2012.

Namibia Ministry of Health and Social Services. (2017). Namibia 2014/15 Health Accounts Report. Windhoek, Namibia.

Nathan, H. L., Seed, P. T., Hezelgrave, N. L., De Greeff, A., Lawley, E., Conti-Ramsden, F., ... & Shennan, A. H. (2018). Maternal and peri-natal adverse outcomes in women with pre-eclampsia cared for at facility-level in South Africa: a prospective cohort study. Journal of global health, 8(2).

Nganou-Gnindjio, C. N., Kenmogne, D., Essama, D. B., Nkeck, J. R., Yanwou, N., & Foumane, P. (2021). Persistent hypertension after pre-eclampsia in a group of Cameroonians: Result of a cross-sectional study and perspectives to reduce its burden in Limited Income Countries. The Journal of Clinical Hypertension, 23(6), 1246-1251.

Ngene, N. C., & Moodley, J. (2020). Maternal deaths due to eclampsia in teenagers: Lessons from assessment of maternal deaths in South Africa. African Journal of Primary Health Care and Family Medicine, 12(1), 1-6.

Njukang, N. E., Thomas Obinchemti, E. G. B. E., Sama, M., Yoah, T. A., & Kamgno, J. (2020). Prevalence and risk factors of hypertensive disorders in pregnancy: the case of mezam division, NWR Cameroon. Journal of Women's Health and Development, 3(3), 247-267.

Nnyepi, M. S., Gwisai, N., Lekgoa, M., & Seru, T. (2015). Evidence of nutrition transition in Southern Africa. Proceedings of the Nutrition Society, 74(4), 478-486.

Noubiap, J. J., Bigna, J. J., Nyaga, U. F., Jingi, A. M., Kaze, A. D., Nansseu, J. R., & Fokom Domgue, J. (2019). The burden of hypertensive disorders of pregnancy in Africa: A systematic review and meta-analysis. The Journal of Clinical Hypertension, 21(4), 479–488.

Nyaga, U.F, Bigna, J.J., Jingi, A.M., Nansseu, J.R., Kaze, A.D., Fokom-Domgue, J., & Noubiap, J. J. (2018). A17575 Hypertensive disorders of pregnancy in Africa: a systematic review and meta-analysis. Journal of Hypertension, 36, e250-e251.

Okafor, U. B., & Goon, D. T. (2020). Physical Activity and Exercise During Pregnancy in Africa: A Review of the Literature. BMC Pregnancy and Childbirth, 20(1), 732. https://doi.org/10.1186/s12884-020-03439-0

Oladele, M. F. C. (2018). Prevalence of hypertensive disorders in pregnant Nigerians and their related factors. African Journal of Medicine and Medical Sciences, 47(3), 297-305.

Omenya, E. R., Makworo, D. D., Nyamongo, D. D., & Mitaki, M. E. (2018). Factors Contributing to Hypertension in Pregnancy Among Mothers Attending Antenatal Clinic in Kisii Teaching and Referral Hospital, Kisii County, Kenya. 4(3), 7.

Owiredu, W., Ahenkorah, L., Turpin, C. A., Amidu, N., & Laing, E. F. (2012). Putative Risk Factors of Pregnancy-Induced Hypertension Among Ghanaian Pregnant Women. Journal of Medical and Biomedical Sciences, 1(3), 62–76.

Palacios & Pena-Rosas. (2010). Calcium Supplementation During Pregnancy for Preventing Hypertensive Disorders and Related Problems (The WHO Reproductive Health Library) [Commentary].

Palma, S., Perez-Iglesias, R., Prieto, D., Pardo, R., Llorca, J., & Delgado-Rodriguez, M. (2008). Iron but not folic acid supplementation reduces the risk of low birth weight in pregnant women without anemia: a case-control study. Journal of Epidemiology & Community Health, 62(2), 120-124.

Pearson, J. T., Watson, E. D., Lambert, E. V., & Micklesfield, L. K. (2015). The Role of Physical Activity During Pregnancy in Determining Maternal and Foetal Outcomes. South African Journal of Sports Medicine, 27(4), 93–96. https://doi.org/10.17159/2078-516x/2015/v27i4a440

Pierre Marie, T., Pascal, F., Robinson, M., Gisele, F., Paul Tjek, B., & Joseph Nelson, F. (2011). Risk Factors for Hypertensive Disorders in Pregnancy: A Report from the Maroua Regional Hospital, Cameroon.

Roberts, J. M., Pearson, G., Cutler, J., & Lindheimer, M. (2003). Summary of the NHLBI Working Group on Research on Hypertension During Pregnancy. Hypertension, 41(3), 437–445. https://doi.org/10.1161/01.HYP.0000054981.03589.E9

Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A.-B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: A WHO systematic analysis. The Lancet Global Health, 2(6), e323–e333. https://doi.org/10.1016/S2214-109X(14)70227-X

Sani, R. N., Connelly, P. J., Toft, M., Rowa-Dewar, N., Delles, C., Gasevic, D., & Karaye, K. M. (2022). Rural-urban difference in the prevalence of hypertension in West Africa: a systematic review and meta-analysis. Journal of Human Hypertension, 1-13.

Schoenaker, D. A., Soedamah-Muthu, S. S., & Mishra, G. D. (2014). The association between dietary factors and gestational hypertension and pre-eclampsia: a systematic review and meta-analysis of observational studies. BMC medicine, 12(1), 1-18.

Sharma, N., Joshi, N., Nazar, G. P., Arora, M., Malhotra, S., Bhatt, G., & Goel, S. (2022). Association of Hypertensive Disorders of Pregnancy (HDP) and tobacco use among women of reproductive age group in India: A secondary data analysis from NFHS-4. Journal of Family Medicine and Primary Care, 11(9), 5799-5806.

Sharami, S. H., Zendehdel, M., Mirblouk, F., Asgharnia, M., Faraji, R., Heirati, S. F. D., & Salamat, F. (2017). Comparison of pre-eclampsia risk factors regarding to severity with control group. Zahedan Journal of Research in Medical Sciences, 19(1).

Said-Mohamed, R., Micklesfield, L. K., Pettifor, J. M., & Norris, S. A. (2015). Has the prevalence of stunting in South African children changed in 40 years? A systematic review. BMC public health, 15(1), 1-11.

Singh, S., Ahmed, E. B., Egondu, S. C., & Ikechukwu, N. E. (2014). Hypertensive disorders in pregnancy among pregnant women in a Nigerian Teaching Hospital. Nigerian medical Journal: Journal of the Nigeria Medical Association, 55(5), 384.

Sih, A. M., Kopp, D. M., Tang, J. H., Rosenberg, N. E., Chipungu, E., Harfouche, M., ... & Wilkinson, J. P. (2016). Association between parity and fistula location in women with obstetric fistula: a multivariate regression analysis. BJOG: An International Journal of Obstetrics & Gynaecology, 123(5), 831-836.

Spracklen, C. N., Ryckman, K. K., Triche, E. W., & Saftlas, A. F. (2016). Physical activity during pregnancy and subsequent risk of preeclampsia and gestational hypertension: a case-control study. Maternal and child health journal, 20(6), 1193-1202.

Spinillo, A., Capuzzo, E., Colonna, L., Piazzi, G., Nicola, S., & Baltaro, F. (1995). The effect of work activity in pregnancy on the risk of severe preeclampsia. Australian and New Zealand journal of obstetrics and gynecology, 35(4), 380-385.

Sewor, C., Obeng, A. A., Eliason, S., Agbeno, E. K., & Amegah, A. K. (2022). Fruits and vegetable intake improves birth outcomes of women with gestational diabetes mellitus and hypertensive disorders of pregnancy.

Statistics South Africa. (2022). The Status of Women's Health in South Africa: Evidence from Selected Indicators (Report No. 03-00-18; p. 53). Stats SA Library Cataloguing-in-Publication (CIP) Data.

Statistics South Africa. (2022). Nearly half of SA women are out of the labour force in Q2:2022. https://www.statssa.gov.za/?p=15668

Suleiman, A. K. (2014). Risk factors on hypertensive disorders among Jordanian pregnant women. Global Journal of health science, 6(2), 138.

Suy, A., Martínez, E., Coll, O., Lonca, M., Palacio, M., de Lazzari, E., Larrousse, M., Milinkovic, A., Hernández, S., Blanco, J. L., Mallolas, J., León, A., Vanrell, J. A., & Gatell, J. M. (2006). Increased Risk of Pre-Eclampsia and Fetal Death in Hiv-Infected Pregnant Women Receiving Highly Active Antiretroviral Therapy. AIDS, 20(1), 59–66. https://doi.org/10.1097/01.aids.0000198090.70325.bd

Symington, E. A., Baumgartner, J., Malan, L., Zandberg, L., Ricci, C., & Smuts, C. M. (2018). Nutrition During Pregnancy and Early Development (NUPED) in Urban South Africa: A Study Protocol for a Prospective Cohort. BMC Pregnancy and Childbirth, 18(1), 308. https://doi.org/10.1186/s12884-018-1943-6

Tchouaket, E., Bouchard, L., Dugas, M., Mboussa, J., & Ekoé, J. M. (2013). The prevalence of obesity in Africa: a systematic review and meta-analysis. Journal of obesity, 2013

Tebeu, P. M., Foumane, P., Mbu, R., Fosso, G., Biyaga, P. T., & Fomulu, J. N. (2011). Risk factors for hypertensive disorders in pregnancy: a report from the Maroua Regional Hospital, Cameroon. Journal of reproduction & infertility, 12(3), 227.

Teklu S, Gaym A. Prevalence and clinical correlates of the hypertensive disorders of pregnancy at Tikur Anbessa Hospital, Addis Ababa, Ethiopia.

Temesgen, M. A. (2017). Factors Associated with Hypertensive Disorder of Pregnancy in Kombolcha. Clinics in Mother and Child Health, 14(4). https://doi.org/10.4172/2090-7214.1000274

Terefe, W., Getachew, Y., Hiruye, A., Derbew, M., Hailemariam, D., Mammo, D., & Muhiye, A. (2015). Patterns of hypertensive disorders of pregnancy and associated factors at Debre Berhan referral hospital, north Shoa, Amhara region. Ethiop Med J, 53(2).

Tesfa E, Nibret E, Gizaw ST, Zenebe Y, Mekonnen Z, Assefa S, et al. (2020) Prevalence and determinants of hypertensive disorders of pregnancy in Ethiopia: A systematic review and meta-analysis. PLoS ONE 15(9): e0239048. https://doi.org/10.1371/journal.pone.0239048

Timmermans, S., Steegers-Theunissen, R. P., Vujkovic, M., Bakker, R., den Breeijen, H., Raat, H., & Steegers, E. A. (2011). Major dietary patterns and blood pressure patterns during pregnancy: the Generation R Study. American journal of obstetrics and gynecology, 205(4), 337-e1.

Trogstad, L., Magnus, P., & Stoltenberg, C. (2011). Pre-eclampsia: Risk factors and causal models. Best practice & research Clinical obstetrics & gynaecology, 25(3), 329-342.

Umesawa, M., & Kobashi, G. (2017). Epidemiology of Hypertensive Disorders in Pregnancy: Prevalence, Risk Factors, Predictors and Prognosis. Hypertension Research, 40(3), 213–220. https://doi.org/10.1038/hr.2016.126

United Nations Population Fund (2021). https://lesotho.unfpa.org/en/news/maternal-death-review-shows-loss-many-womens-lives-could-been-avoided-if-action-was-taken

Unwin, N. (1999). Tackling the emerging pandemic of non-communicable diseases in sub-Saharan Africa: The essential NCD health intervention project. Public Health, 113(3), 141–146. https://doi.org/10.1016/S0033-3506(99)00139-0 van Middendorp, D., Asbroek, A. T., Bio, F. Y., Edusei, A., Meijjer, L., Newton, S., & Agyemang, C. (2013). Rural and urban differences in blood pressure and pregnancy-induced hypertension among pregnant women in Ghana. Globalization and health, 9(1), 1-8.

Wall, L. L. (2012). A framework for analyzing the determinants of obstetric fistula formation. Studies in Family Planning, 43(4), 255-272.

Wang, W., Xie, X., Yuan, T., Wang, Y., Zhao, F., Zhou, Z., & Zhang, H. (2021). Epidemiological Trends of Maternal Hypertensive Disorders of Pregnancy at the Global, Regional, and National Levels: A Population-Based Study. BMC Pregnancy and Childbirth, 21(1), 364. https://doi.org/10.1186/s12884-021-03809-2

Washington, B. B., Raker, C. A., Kabeja, G. A., Kay, A., & Hampton, B. S. (2015). Demographic and delivery characteristics associated with obstetric fistula in Kigali, Rwanda. International Journal of Gynecology & Obstetrics, 129(1), 34-37.

Wei, J., Liu, C. X., Gong, T. T., Wu, Q. J., & Wu, L. (2015). Cigarette smoking during pregnancy and pre-eclampsia risk: a systematic review and meta-analysis of prospective studies. Oncotarget, 6(41), 43667–43678. https://doi.org/10.18632/oncotarget.6190

World Bank(2019). Lesotho Poverty Assessment: Poverty and Inequality Remain Widespread Despite Decline,

https://www.worldbank.org/en/country/lesotho/publication/lesotho-poverty-assessment-poverty-and-inequality-remain-widespread-despite-decline

World Food Programme (2023). Namibia Country Brief, July 2023, https://www.wfp.org/countries/namibia

Wolde, Z., Segni, H., & Woldie, M. (2011). Hypertensive disorders of pregnancy in Jimma University specialized hospital. Ethiopian journal of health sciences, 21(3).

World Health Organisation. (2018). WHO Recommendations: Drug Treatment for Severe Hypertension in Pregnancy.

World Health Organisation et al. (2015). Trends in Maternal Mortality: 1990-2015.

World Health Organisation. (2016). WHO recommendations on antenatal care for a positive pregnancy experience. ISBN 978 92 4 154991 2

Wiertsema, C. J., Mensink-Bout, S. M., Duijts, L., Mulders, A. G., Jaddoe, V. W., & Gaillard, R. (2021). Associations of DASH diet in pregnancy with blood pressure patterns, placental hemodynamics, and gestational hypertensive disorders. Journal of the American Heart Association, 10(1), e017503.

Wolde, Z., Segni, H., & Woldie, M. (2011). Hypertensive Disorders of Pregnancy in Jimma University Specialized Hospital. 21(3), 8.

Xiong, X., Fraser, W. D., & Demianczuk, N. N. (2002). History of abortion, preterm, term birth, and risk of pre-eclampsia: a population-based study. American Journal of obstetrics and gynecology, 187(4), 1013-1018.

Ye, C., Ruan, Y., Zou, L., Li, G., Li, C., Chen, Y., Jia, C., Megson, I. L., Wei, J., & Zhang, W. (2014). The 2011 Survey on Hypertensive Disorders of Pregnancy (hdp) in China: Prevalence, Risk Factors, Complications, Pregnancy, and Perinatal Outcomes. PLoS ONE, 9(6), e100180. https://doi.org/10.1371/journal.pone.0100180

Ying, W., Catov, J. M., & Ouyang, P. (2018). Hypertensive disorders of pregnancy and future maternal cardiovascular risk. Journal of the American Heart Association, 7(17), e009382.

Zhao, W., Di, J., Huang, A., Yang, Q., Hu, H., & National Center for Women and Children's Health, Chinese Center for Disease Control and Prevention, Beijing, China. (2021). Incidence and Risk Factors of Hypertensive Disorders of Pregnancy—8 Provinces, China, 2014–2018. China CDC Weekly, 3(22), 476–482.

Ziaei, S., Norrozi, M., Faghihzadeh, S., & Jafarbegloo, E. (2007). A randomized placebo-controlled trial to determine the effect of iron supplementation on pregnancy outcome in pregnant women with hemoglobin≥ 13.2 g/dl. BJOG: An International Journal of Obstetrics & Gynaecology, 114(6), 684-688

Appendix 1: Correlation Coefficient Matrix Output

<u>Table 5.1: Correlation Coefficient Matrix</u>

Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) HDP4	1.000													
(2) country_code	0.151*	1.000												
(3) maternal_age2	0.101*	0.199*	1.000											
(4) BMI_categories	0.069*	0.085*	0.210*	1.000										
(5) marital_status	-0.054	-0.444*	0.122*	0.085*	1.000									
(6) place_of_resid~e	0.144*	0.277*	0.076*	0.136*	-0.077*	1.000								
(7) parity	0.098*	0.112*	0.626*	0.083*	0.166*	-0.056*	1.000							
(8) educational_st~s	0.083*	0.213*	-0.044	0.238*	-0.098*	0.282*	-0.254*	1.000						
(9) employment_sta~s	-0.017	-0.027	0.180*	0.066*	0.031	0.128*	0.036	0.081*	1.000					
(10) iron_suppleme~e	0.069*	0.187*	0.107*	0.005	-0.120*	0.141*	-0.008	0.160*	-0.029	1.000				
(11) fruits_consum~n	-0.042	-0.178*	0.037	0.063	0.031	0.123*	-0.091*	0.218*	0.119*	-0.020	1.000			
(12) vegetables_co~n	-0.019	-0.214*	0.087*	0.016	0.101*	0.049	0.026	0.076	0.181*	0.037	0.344*	1.000		

(13) level_physica~y -0.091* -0.315* -0.008 -0.060 0.134* -0.192* 0.030 -0.189* 0.374* -
0.248* 0.054 0.072 1.000

(14) smoking_status 0.041 0.104* 0.170* -0.047 0.024 0.076* 0.230* -0.147* -0.004
0.041 -0.103* -0.038 0.009 1.000

*** p<0.01, ** p<0.05, * p<0.1

Appendix 2: Key Definitions

Hypertensive Disorders of Pregnancy definition adopted for this study is defined by the International Society for the Study of Hypertension of Pregnancy (ISSHP) as chronic hypertension and pregnancy-induced hypertension whereby;

Chronic hypertension is characterized by a diastolic blood pressure of 90mmg or more and a systolic blood pressure of 140mmHg or more that develops before pregnancy and 20 weeks of gestation and where superimposed pregnancy-induced hypertension may develop among those with pre-existing hypertension.

Pregnancy-induced hypertension is hypertension that develops after 20 weeks of gestation and is detected with an average of two blood pressure readings of 90mmHg dBP and 140mmHg sBP, and / with proteinuria and with/without edema, and/ with signs and symptoms of convulsions for pre-eclampsia and eclampsia, respectively.

Appendix 3: Summary Turnitin Report

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