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南方醫科大學

冈比亚上河地区妊娠期高血压疾病（PIH）的患病率及相关危险因素调查

Study on The Prevalence and Associated Factors of Pregnancy Induced-Hypertension (PIH) in Upper River Region, The Gambia

硕 士 学 位 论 文

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上河地区（冈比亚）妊娠期高血压疾病（PIH）的患病率及相关因素

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摘　要

本研究调查了冈比亚上河地区（URR）孕妇妊娠期高血压疾病（PIH）的患病率及相关因素。研究采用 1:1 病例对照设计，收集了 292 名参与者（146 例病例和 146 例对照）的主要数据，并使用了国家地区卫生信息系统 2（DHIS2）的次要数据。通过描述性统计、独立样本 t 检验、卡方检验和二元逻辑回归分析，使用 SPSS 25 版软件对数据进行分析，以识别显著关联。分析结果显示，PIH 的患病率显著，并在多个领域观察到显著相关性。2024 年，该地区 PIH 的患病率为 4.04%，表明与其他六个地区相比，上河地区存在显著的公共卫生负担。社会经济因素，如较低的家庭收入，与 PIH 密切相关，收入最低的女性患 PIH 的几率是收入最高女性的 8.401 倍（aOR=8.401，p=0.001）。既往 PIH 病史是 PIH 复发的最强预测因素，其几率显著增加（aOR=27.057，p<0.001），且随着孕周的增加，PIH 的风险显著上升，尤其是在妊娠中期（aOR=6.277，p=0.001）。慢性病史也显著增加了 PIH 的风险（cOR=7.301，p<0.001），而孕期医疗监护与较高的 PIH 几率相关（cOR=1.901，p=0.021），这可能是由于检测率的提高。

研究结果强调了 PIH 的多因素性质，并强调需要采取有针对性的公共卫生干预措施，如改善产前护理的可及性和开展社区教育项目。加强医疗体系以确保 PIH 的早期检测和管理，对于降低其患病率和改善孕产妇健康结局至关重要。

关键词：患病**率**；妊娠期高血压疾**病**；相关因**素**；上河地区；孕产妇健**康**

Study on The Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region, The Gambia

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ABSTRACT

This study investigates the prevalence and associated factors of Pregnancy-Induced Hypertension (PIH) among pregnant women in the Upper River Region (URR) of The Gambia. Using a 1:1 case-control design, primary data was collected from 292 participants (146 cases and 146 controls) and secondary data from the national District Health Information System 2 (DHIS2).

Descriptive statistics, independent t-tests, chi-square tests, and binary logistic regression

were employed to analyze the data using SPSS version 25, employing analysis to identify significant associations. The results from the analyses revealed a notable prevalence of PIH and observed significant correlations in several domains. The prevalence of PIH in the region was found to be 4.04% in 2024, indicating a significant public health burden compared to the other six (6) regions of The Gambia. Socio-economic factors such as lower household income, were strongly associated with PIH, with women in the lowest income brackets having 8.401 times higher odds (aOR=8.401, p=0.001) of developing PIH compared to those in the highest income group. History of PIH previously stand out to be the strongest predictor of recurrence of PIH with increased odds (aOR=27.057, p<0.001) and the risk of PIH increased significantly with advancing gestational age particularly in second trimester (aOR=6.277, p=0.001). History of chronic health conditions also significantly increased the risk of PIH (cOR=7.301, p<0.001) and medical supervision during pregnancy was associated with higher odds of PIH (cOR=1.901, p=0.021), likely due to increased detection rates.

The findings highlight the multifactorial nature of PIH and underscore the need for targeted public health interventions, such as improved access to antenatal care, community-based education programs. Strengthening healthcare systems to ensure

early detection and management of PIH is critical to reducing its prevalence and improving maternal health outcomes.

KEYWORDS: Prevalence; Pregnancy-Induced Hypertension; Associated Factors; Upper River Region, Maternal Health

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Chapter I Introduction

1.1 Background Information

Pregnancy-Induced hypertension (PIH), which includes gestational hypertension, pre-eclampsia, and eclampsia is a major public health issue that impacts a considerable number of pregnant women and fetus. These conditions increase maternal and newborn morbidity and mortality by posing serious health risks to the expectant mother and fetus (1,2). A considerable percentage of pregnancies are affected by PIH, though prevalence rates vary by location (3). PIH is characterized by high blood pressure with or without proteinuria, and can result in pre-eclampsia and severe complications such as eclampsia, which put the mother and the fetus at a significant risk (4,5). The cause of PIH is idiopathic but it is associated with various predisposing factors and characterized by two of the following three signs; Edema, Hypertension and Proteinuria (6). This disorder causes substantiate morbidity and mortality for both the mother and the fetus despite improved prenatal care (6,7).

Pregnancy-related hypertensive conditions are a significant contributor to serious health issues, enduring impairment, and mortality for both pregnant

mothers and their infants, accounting for around 14% of maternal mortality on a global scale, with the huge burden seen in low-and middle-income countries (4,8). Enhancing maternal care during the period surrounding childbirth is essential for meeting the global health objectives outlined in the United Nation (UN) Sustainable Development Goals (SDGs) (4,9). Initiatives aimed at the prevention and mitigation of health complications and fatalities during pregnancy and parturition, could also serve to tackle the stark disparities in maternal and neonatal health around the world (10). In order to realize these objectives, it is imperative for healthcare professionals, administrators, policymakers, government and other key players to have access to current, evidence-informed guidance that shapes clinical strategies and procedures (5,11).

In The Gambia, particularly in the Upper River Region, the prevalence of PIH is a pressing public health issue. The region is challenged with limited access to healthcare services, high rates of poverty, and low levels of education; all of which contribute to the increased risk of hypertensive disorders during pregnancy (12). According to studies, the prevalence of PIH varies significantly ranging from 5 to 10 percent, depending on socio-economic and demographic factors in sub-Saharan Africa (13). The estimated maternal mortality rate in The Gambia is 861 per

100,000 live births, with hypertensive disorders accounting for a significant amount of this rate (14).

1.1.1 What is Pregnancy Induced Hypertension

Hypertension is a chronic or non-communicable disease and has a great impact to antenatal mothers. Hypertension is also known as high blood pressure. It occurs when blood is forced through the arteries at an increased pressure (15,16).

There is no universally agreed definition of hypertension but most authorities would accept that a sustained resting blood pressure of more than 140/90 mmHg is a defined hypertension; where 140mmHg is systolic pressure, the maximum blood pressure in the arteries when the heart contracts and pumps blood to the arterial wall while the 90mmHg is the diastolic pressure, the minimum blood pressure between beats when the heart relaxes to be fill with blood (16,17). Furthermore, this would be categorized as:

- **Mild hypertension:** when diastolic blood pressure is between 90-100 mmHg.
- **Moderate hypertension:** when diastolic blood pressure is between 101-120mmHg.
- **Severe hypertension:** when diastolic blood pressure is above 120mmHg

Pregnancy-Induced Hypertension also referred to as gestational hypertension or pre-eclampsia is the elevation of the arterial blood pressure after the twentieth (20^{th}) week of gestation/pregnancy and normally goes away after delivery (18). Or it is a specific disease of pregnancy occurring in the second half of pregnancy and is also denoted to as toxemia, is hypertension that appears after 20 weeks of gestation while the blood pressure of the woman had previously been normal (8,19). Characterized by two of the following three signs; Edema, Hypertension and Proteinuria (6).

A blood pressure of greater than or equal to 140/90mmHg without or with proteinuria of no greater than trace level after 20 weeks of gestation is considered as Pregnancy-Induced Hypertension (6). Blood Pressure that is > 140/90 mmHg measured twice after a rest period of a pregnant woman, or ≥ 160/110 mmHg measured once in a pregnant woman who was previously normotensive, could be associated with PIH (2,6).

Pre-eclampsia occurs in 5-7 percent of all pregnancies and proteinuria and hypertension serve as its broad definitions (20). Pre-eclampsia with convulsions that cannot be attributed to another neurologic illness is included in the category of eclampsia. Eclampsia usually appears at the end of pregnancy and affects approximately one in 1,600 pregnancies (6). Premature birth, intrauterine growth

retardation (IUGR), placental abruption, intrauterine death, and maternal morbidity and mortality are all linked to PIH (21).

1.1.2 Types of PIH

Recent work undertaken by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy describes four major categories of hypertension during pregnancy:

1. **Chronic Hypertension-**This is known hypertension before pregnancy or a rise in blood pressure >140/90mmHg before 20 weeks' gestation and persisting six (6) weeks after delivery.

2. **Gestational Hypertension-**This is the development of hypertension without other signs of pre-eclampsia. It is diagnosed after resting, the woman's blood pressure rises above 140/90mmHg, on at least two occasions, no more than 1 week apart after 20th week of pregnancy in a woman known to be normotensive.

3. **Pre-eclampsia-**This is a more severe form of gestational hypertension and diagnosed on the basis of Systolic of ≥160 mmHg, or Diastolic of ≥110 mmHg with proteinuria, when proteinuria is measured as >1+ on dipstick or >0.3g/L of protein in a random clean catch specimen or an excretion of 0.3g protein/24 hours. This can lead to serious complications such as eclampsia and HELLP syndrome (Hemolysis, Elevated Liver enzymes, Low Platelets).

4. **Eclampsia**-This is defined as the new onset of seizures/convulsions during pregnancy or postpartum, unrelated to other cerebral pathological conditions, in a woman with pre-eclampsia, representing a life-threatening condition (7).

1.1.3 Etiology of PIH

The pathophysiology of PIH is not fully understood, but it is believed to involve a combination of genetic, environmental, and immunological factors (22). The etiology of PIH remains unknown, although some conditions may increase the risk of developing it which is term as a predisposing factor and they are: Homeostatic disturbances (Increase plasma volume, extra cellular volume), Coagulation factors (fibrin deposition in capillaries, uterus, maternal kidneys and lungs)**,** Hormonal factors**,** Primigravida**,** Multiple pregnancy, Obesity, Polyhydramnios, Diabetes Mellitus and Patients with history of hypertension (pre-existing hypertension), family history of hypertension, women younger than 20 years or older than 40 years (23–25).

1.1.4 Signs and Symptoms

- **Frontal headaches:** Due to cerebral edema.
- **Epigastric/Abdominal pain:** Caused by hemorrhage into and distension of the liver capsule.

- **Nausea and vomiting:** This may be due to edema causing pressure on the vomiting center or in association with headaches and Epigastric pain.
- **Visual disturbances:** Blurring vision, photophobia, spots or flashes in front of the eyes due to edema of the retina.
- **Oliguria:** A diminished in urine output and it is a key sign of PIH.
- **High blood pressure:** Pressure reading of more than 140/90mmHg.
- **Protein in urine:** Presence of protein in the urine during urinalysis.
- **Edema** (swelling of the lower limbs): Leading to sudden weight gains (20,26).

1.1.5 Medical Management

The cure for PIH or pre-eclampsia or eclampsia is to deliver the baby. Early and regular attendance to antenatal clinic is encouraged to obtain base line information about the Blood Pressure recording and to detect any proteinuria. When considering treating hypertension in pregnancy one must ask three questions:

- Will the treatment result in fewer maternal complications?
- Will the prenatal morbidity and mortality be reduced?
- Are there long-term effects of the treatment for either mother or baby (6,26).

Depending upon the severity of the disease a mother may be admitted. Treatment is symptomatic because the cause of PIH is unknown and it is as follow:

Bed rest: The mother should be nursed in bed and will be encouraged to adopt a sitting position or to lie on her left side in order to encourage uterine blood flow. Where pre-eclampsia is severe high dependency care should be instituted.

Diet: Should be rich in protein, fiber and vitamins but low in carbohydrate and salt. Fluids should be encouraged.

Weight: Should be estimated and recorded twice weekly if the mother is ambulant and edema should be observed daily.

Urine should be tested for protein and ketones twice daily and specimens should be sent to the laboratory as ordered, so that the levels of protein can be estimated. The level of protein indicates the degree of vascular damage.

Fluid intake and output should be continuously measured. Adequate urine output signifies good renal function; Oliguria or urinary suppression may occur if the disease becomes severe.

Blood pressure is ascertained 4-hourly in moderate pre-eclampsia but will be taken 2-hourly or more frequently if the mother is severely affected.

Abdominal examination will be carried out at least twice daily. Any discomfort, tenderness or pain experienced by the mother should be recorded and reported immediately to the gynecologist or midwife.

The fetal Heart Rate should be elicited when the abdominal examination is performed.

Kick charts are maintained to monitor the degree of fetal movement and serial ultrasonic scans are undertaken to assess fetal growth.

Sedation may be prescribed if the mother needs to be encouraged to rest and sleep. Sedative do not improve the pre-eclampsia.

Hypotensive agents are prescribed where there is marked increase in the blood pressure. Drugs such as methyldopa, hydralazine and nifedipine can be given. This treatment is initiated to prevent cerebrovascular accidents (CVAs).

Anticonvulsant therapy may be used where the condition is severe leading to eclampsia and magnesium sulfate ($MgSO_4$) is the drug of choice (27,28).

1.1.6 Labor Management

In the management of PIH. The gynecologist or midwife should remain with the mother throughout the course of labor. The condition can suddenly worsen at any time and it is essential to document the presence of oedema, the blood pressure, urinary output and the result of urinalysis at the outset, so that any deviation will

be noted and medical assistance sought. The mother should be made as comfortable as possible which will necessitate attention to oral and bodily hygiene at regular intervals. The bed linen should be changed frequently as amniotic fluid usually drains throughout. Positioning the mother on her side will prevent supine hypotension (6,23).

Bladder care: is essential and the mother should be encouraged to void urine regularly. All urine specimens should be tested for protein, ketones and glucose and the results recorded.

The blood pressure and pulse rate: should be elicited half-hourly. Respirations may need to be observed hourly if there is pulmonary edema and the temperature should be taken 4-hourly.

The fetal heart: should be recorded at least half-hourly if the pinard's stethoscope is used. The clinician should conscientiously record all findings and summon medical assistance if any deviation from the normal is observed (6,20).

1.1.7 Effects of PIH on the Mother

- PIH condition may worsen leading pre-eclampsia and eclampsia
- Placental abruption may occur with associated complications.
- Hematological disturbance can occur and the kidneys, lungs, heart and liver may be seriously damaged.

- Capillaries within the fundus of the eye may irreparably damage and blindness can occur (Retinopathy) (10,20).

1.1.8 Effects of PIH on the Fetus

- Reduced placental function can result in low birth weight. This will be further aggravated if the mother smokes.
- There is an increased incidence of hypoxia in both the antenatal and intranatal periods.
- Placental abruption, if minor will contribute to fetal hypoxia; if major, intra-uterine death will occur.
- Early delivery if the disease worsens, or if abruption occurs leading to the delivery of preterm baby requiring resuscitation (7,20).

1.2 Problem statement and Justification

Hypertension is a serious cause of morbidity and mortality, a leading cause of death worldwide (4,29). Globally hypertension is identified as the third factor for disability in life. The global incidence ranges from 0% - 44% depending on population studied (1,3). It is one of the primary risk factors for heart diseases and stroke (21,30). The incidence of hypertension varies markedly in various countries (11). In most not all, communities, blood pressure tends to rise with age. PIH one

of the commonness hypertensions and yet a serious condition seen in obstetrics (31). It occurs mostly among young women who had history of PIH in their previous pregnancy and occur in 7-10% of all pregnant women (15). The High Blood Pressure Education Program (2000) has classified HDP as pregnancy induced hypertension/gestational hypertension, preeclampsia, eclampsia syndrome, and superimposed preeclampsia on chronic hypertension (8).

According to the World Health Organization (WHO), the lethal trifecta of pregnancy is PIH, hemorrhages, and infections, which contribute significantly to maternal mortality and morbidity and claim the lives of at least one woman every 7 minutes (32,33). These complicate up to 5%~10% of pregnancies worldwide (9). Globally, the incidence of Hypertensive Disorders of Pregnancy (HDP) has increased from 16.30 million to 18.08 million from 1990 to 2019, a total increase of 10.9% over two decades (3,33). The global burden is alarming and there is a spike increase of cases in low- and middle-income countries (LMICs) (1,16,34).

PIH is a global public health concern with an ever-increasing incidence and prevalence, and it is estimated that pre-eclampsia and eclampsia contribute to the death of a woman every 3 minutes worldwide (15). Like many non-communicable diseases, the risk of hypertension are behavioral, environmental/genetic factors (29,35). In severe cases, PIH complicates 3-5% of first pregnancy and 1-2% of

subsequent pregnancies with about 5-10 cases being severe (8). It is the commonest disorder diagnosed by obstetrician in clinical practice (36,37).

Approximately more than one million women die of PIH and its complications worldwide per annum (4,19). In Africa, the latest estimate of World Health Organization shows that more than 30 million people in Africa are hypertensive and if effort is not made, by 2030 three quarters of all death in Africa will be attributed to hypertension (3,38). Many black communities, both in Western Africa and North America have a high incidence of hypertension than the Asian region (1,3,33).

The overall prenatal mortality in PIH is about 35 per 1000 total births but may reach 160 per 1000 births in severe cases, PIH complicates 3-5% of first pregnancy and 1-2% of subsequent pregnancies with about 5-10 cases being severe (7,21). PIH is among the leading causes of maternal mortality worldwide accounting for about 17% of all maternal deaths (4,29).

In developed countries, pre-eclampsia is responsible for the death of many mothers and about 5000 to 6000 deaths of babies (9,11). Infants of mothers suffering from PIH or pre-eclampsia have five times risk of dying than mothers without pre-eclampsia mainly because of the preterm birth (34,39). In the United States PIH affect an estimated 240,000 women per year (4,10). Developing

countries have had a persistently higher rate of maternal and child mortality due to PIH and pre-eclampsia in comparison with developed countries (1,3,14). In Africa, PIH is the third leading cause of maternal morbidity (after hemorrhage and malaria in pregnancy) and the second leading cause of maternal deaths principally due to eclampsia (3,33).

PIH can lead to serious complications such as high blood pressure whereby there is an increase in resistance of blood vessels; this may hinder blood flow in many different organs or systems in the expectant mother leading to maternal deaths (18,36,38). These deaths cause more than one million children to be motherless annually and the same time reduces the household income significantly (4,18). PIH also led to fetal underdevelopment, low birth weight and death. It is responsible for 15% of preterm birth in developed countries (40,41). Women diagnosed with PIH, will also face a wide range of medical issues such as liver failure, kidney problems, seizures, pulmonary edema, coma and finally death (2,19).

In The Gambia hypertension is on the increase and a study found that about half of Gambian adults aged ≥35 years had hypertension (16). A report indicates that 9.5% of adults over 15 years in The Gambia are hypertensive (14). In the same Gambia 5.4-folds increase in maternal death is due to PIH and its related

complications during the malaria season (14,34). In view of the fact within The Gambia, PIH is a major health problem. The Gambia is grabbing with the burden of PIH with a total of 3177 diagnosed cases in 2023, in which 489 of the cases were registered in the Upper River Region (URR) (42). Nonetheless, researches in this area are very minimal. The Upper River Region of The Gambia may have unique challenges related to PIH due to factors such as geographical isolation, cultural practices, lifestyles, nutritional and environmental factors. The region's remoteness can result in delayed access to prenatal care and a lack of timely intervention for PIH, in order to avert maternal complications.

According to the national records from the Health Management Information System (HMIS) the region is seeing a steadily increase in the number of PIH cases from 2019 to 2023. While there may be some data on the prevalence of PIH in The Gambia, specific rates for the Upper River Region might be sparse or outdated, limiting the understanding of the true extent of the problem. Below is the absolute number of PIH in the districts of the region for the past five (5) year:

Table1-1: Trend of PIH in the Upper River Region from 2019-2023

Variables	Pregnancy-Induced Hypertension							
Period/Unit	**URR**	**Basse**	**Jimara**	**Kantora**	**Sandu**	**Tumana**	**Wuli/E**	**Wuli/W**
2019	**330**	126	57	48	5	0	87	7
2020	**362**	170	60	29	7	0	65	31
2021	**377**	191	73	39	11	1	21	41
2022	**512**	233	120	69	13	0	38	39
2023	**489**	221	106	74	15	0	39	34

Source: *DHIS2-Health Management Information System (HMIS), The Gambia, Ministry of Health*

1.2.1 Significance

The significance of the study on the Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region lies in the following:

Public Health Impact: PIH is a major public health issue in the globe, and knowing the trend and associated factors of this disease in the region will help in the formulation of strategies to prevent the burden of the disease to antenatal. Future public health strategies will be informed by the study's findings, which will offer crucial insights into how well an intervention work to reduce the burden of PIH in the country. The results of the study can be utilized to develop PIH

health education programs and equip medical personnel the knowledge and skills they need to lower maternal morbidity and mortality. Although there is no medical treatment for total elimination of the condition, but it can be managed to ensure a safe delivery with appropriate and prompt intervention.

Economic Impact: In The Gambia, PIH has a major economic impact because it causes women of childbearing age to be less productive, raises healthcare expenses, and decreases economic growth. If the study finds that the prevalence and associated factors of PIH has an economic impact, then recommendations like effective preventive strategies and effective medical intervention will help reduce the economic burden of the disease on individuals and the country as a whole.

Policy Implications: Policymakers and healthcare professionals in The Gambia will find great value in the study's conclusions, which will direct the creation of interventions tailored specific to the region and enhance maternal health outcomes. Additionally, it will help the concerned authorities make inform policy decisions pertaining to PIH and allow them to develop critical intervention plans that will improve pregnant women's health and lessen PIH complications. Understanding the disease's national trend will also assist policymakers in scaling up programs that reach a large number of the population and lessen the burden of the disease in the country.

Research Gaps: The study will also contribute in addressing gaps in the current body of knowledge regarding the prevalence, treatment, prevention, and mitigation of PIH in the area. Through the integration of data sources, primary and secondary data. The study seeks to present a more comprehensive picture of PIH in the upper River Region and guide prevention, early detection, and management strategies. Being URR, The Gambia's first study of this kind, it will set the stage for future research that aims to fill in some of the gaps in the literature

Examining the prevalence and associated factors of PIH in the region, the study will help us better understand how well ongoing intervention strategies are working in mitigating the burden of the disease in the nation. Current research may not be adequately taken into consideration the regional disparities and the complex factors causing PIH within The Gambia. There is a need for more localized data to guide focused interventions and policies.

1.2.2 Rationale

The rationale for conducting this comprehensive study on the Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region is to address a significant public health issue in the country. PIH is a major cause of illness and maternal death among antenatal in The Gambia, and one of the most effective tools for preventing or mitigating PIH and its complication is

by conducting researches and looking at the factors associated to the disease, then work around strategies that are in line with WHO standards to adopt.

In additions, this study was carried out in order to integrate primary and secondary data so as to provide a more comprehensive understanding of PIH in the Upper River Region. This approach will make it possible to examine both broad trends and specific regional factors. One way to gain an understanding of the prevalence and characteristics of PIH cases in the area is to analyze the data that is currently available from the Health Management Information System (HMIS) and other sources. However, the use of questionnaires to collect primary data will enable the investigation of factors like dietary habits, lifestyle choices, personal experiences with PIH, and cultural customs that are not covered by the secondary data sources. By investigating the Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region, researchers will be able to close gaps in the existing literature on the subject and offer crucial information about the measures needed in reducing the burden of the disease. Policy decisions pertaining to PIH in The Gambia and other nations dealing with similar health issues will be informed by this data.

1.3 Research Hypothesis

The prevalence of Pregnancy-Induced Hypertension (PIH) in the Upper River Region of The Gambia is significantly higher among pregnant women and is associated with socio-economic factors, nutritional and lifestyle behaviors and health and pregnancy-related factors.

1.4 General Objective

Assessing the prevalence of pregnancy-induced hypertension in pregnant women in the Upper River Region of The Gambia as well as its associated factors is the main objective.

1.5 Specific Objectives

I. To assess the prevalence of PIH in the Upper River Region.

II. To assess the association between the risk of developing PIH and socio-economic factors.

III. To investigate the influence of family history and lifestyle factors (such as nutrition and physical activity) on the prevalence of PIH.

IV. To provide suggestions for public health interventions meant to lower the prevalence of PIH and improve maternal health in the region.

1.6 Research Questions

I. What is the prevalence of PIH in the Upper River Region?

II. What is the association between socio-economic factors and this population's risk of developing PIH?

III. What lifestyle choices and the degree to which family history of hypertension are associated to an increased risk of PIH?

IV. What public health measures can be taken to reduce the Upper River Region's risk of PIH?

Chapter II Literature Review

2.1 Epidemiology of PIH

The epidemiology of Pregnancy Induced Hypertension reveals significant variations influenced by socio-economic, cultural, and healthcare factors. A substantial percentage of pregnancies are impacted by PIH, with substantial variations across different regions of the world in prevalence rates (3). PIH and Pre-Eclampsia remain a major cause of maternal and infant morbidity and mortality worldwide, contributing significantly to adverse maternal and neonatal outcomes (15,43). It is one of the commonest medical disorders diagnosed by obstetricians in clinical practice. Approximately 100,000 women die worldwide per annum because of pregnancy induced hypertension (33). It is said that PIH, pre-eclampsia and eclampsia contribute to death of a woman every 3 minutes worldwide (10,28). The global maternal mortality rate is estimated to be 400 per 100,000 live births due to pregnancy or childbirth (3,26). Approximately 6% of pregnancies are affected by PIH, which causes complications for the mother (4,8). Globally, The World Health Organization (WHO) reports about 14% of the global maternal deaths were due to pre-eclampsia and eclampsia, with the burden disproportionately affecting women in low- and middle-income countries (44). 10 to 15 percent of all pregnancies around the world, complicated by hypertension are

associated with pre-eclampsia and eclampsia, making them the leading causes of maternal and perinatal morbidity and mortality. Additionally, it is believed that 5–8% of pregnant women worldwide suffer with Pregnancy-Induced Hypertension, one of the hypertensive diseases of pregnancy (45). In developed countries, the prevalence of PIH is lesser compared to developing nations, with rates ranging from 5% to 7% of pregnancies. However, recent studies indicate a rising trend in PIH among certain populations, particularly among women of advanced maternal age and those with pre-existing health conditions such as obesity and diabetes (46,47). For instance, a study in the United States reported that the prevalence of preeclampsia has increased from 3.4% in 1980 to 4.4% in 2010, highlighting a concerning upward trend (48).

The prevalence of PIH varies greatly throughout the world, with low-resource settings showing higher rates (9). It is estimated that between 5 - 14% of pregnant women in sub-Saharan Africa suffer from hypertensive disorders. Poor nutrition, limited knowledge about the dangers of hypertension during pregnancy, and limited access to healthcare services are some of the factors that contribute to the high prevalence of hypertension disorders in pregnancy (16,49,50). Between 1990 and 2019, the incidence of PIH increased globally, rising from 16.30 million to 18.08 million, representing a total rise of 10.9% over two decades (8). A recent

study indicated that the global and regional prevalence of hypertension is constantly increasing steadily in sub-Saharan Africa and concluded that the escalating prevalence, suboptimal treatment, poor detection rate, and poor control rates in this region is associated with risk factors like unhealthy lifestyle, obesity, unfavorable socio-economic condition and disparities attributed to demographic factors (43).

Despite numerous basic, clinical and epidemiologist studies that have been conducted over the past century, knowledge of the etiology and pathogenesis of PIH remain elusive, because the physiology of PIH has not yet been elucidated, clinical trials have failed to demonstrate any effective prevention or treatment strategies, apart from early delivery in case where the disorder is severe (2,51). PIH often occurs among primigravida women, common in twin pregnancies, women over the age of 35, women with chronic hypertension or who had hypertension in a previous pregnancy, African-American women, and women with diabetes (6,8). PIH affects 2.73% of women globally, predominantly eclampsia, chronic hypertension, and pre-eclampsia, which affect 0.28%, 0.29%, and 2.16% of pregnant women, respectively (15). Over 830 women's deaths reported daily in 2015 were associated with pregnancy and childbirth complications (9). The bulk of these deaths practically all happened in low-resource nations, which could have

been avoided (9,29). Women with PIH are five times more likely to experience perinatal death compared to women without PIH (28,52). Around the world, hemorrhages, hypertensive disorders, and sepsis account for over half of all maternal deaths (24,47).

The burden of PIH in developing countries is significant, with prevalence rates often surpassing 10% to 20% of all pregnancies (53). A systematic review indicated that the incidence of pre-eclampsia in sub-Saharan Africa ranges from 4% to 20%, with significant variations between countries (54). This increased burden can be attributed to several factors, including limited access to quality healthcare services, socio-economic differences, and a higher prevalence of risk factors such as malnutrition, lifestyles and infectious diseases (36,54). Hypertension is high in the African region and accounts for about 46% of all cases and a very high percentage is undiagnosed (55). Pregnancy-related hypertension illnesses are thought to be the cause of 9.1% of maternal deaths in Africa (4,14).

In sub-Saharan Africa, the burden of PIH is particularly high, with studies showing that the prevalence of hypertensive disorders in pregnancy can reach up to 15% in some regions (53). The lack of adequate healthcare infrastructure, limited knowledge about the condition and resources exacerbates the situation, leading to poor maternal health outcomes (56). For instance, recent studies reported that

preeclampsia accounted for 25% of maternal deaths, underscoring the critical need for improved maternal healthcare services and interventions (38,53). In 2015, problems connected to pregnancy and childbirth claimed the lives of an estimated 303,000 women and adolescent girls, with low-resource settings like Africa accounting for about 99% of these deaths (3). A study in Ethiopia by Getahun et al shows that 10% of all maternal deaths in Ethiopia are associated with Pregnancy Induced Hypertension (19).

In The Gambia, studies have indicated that the prevalence of PIH is particularly disturbing, where maternal mortality rates associated with hypertensive disorders are still startlingly high (12). The Upper River Region, characterized by its rural population has scarce resources and faces unique challenges in effectively managing PIH (31,57). The lack of adequate healthcare facilities and limited resources complicate the management of PIH, resulting in increased maternal mortality rates associated with PIH (37). A study that examined the knowledge of hypertension risk factors and symptoms among Gambian women, revealed that a small fraction of the study participants was aware of hypertension risk factors, which can influence the management of PIH since awareness is concern (58). Efforts to address the burden of PIH in The Gambia must focus on enhancing access to antenatal care, increasing community awareness about the importance of early

detection and management of hypertensive disorders, strengthening the healthcare workforce to better support pregnant women and venture into more researches on this area as limited studies are available on the epidemiology of PIH in The Gambia.

2.2 Socio-Economic Factors and PIH

Socioeconomic status is a critical determinant of health outcomes, including the prevalence of PIH. Research has shown that women from lower socioeconomic backgrounds are at a higher risk of developing hypertensive disorders during pregnancy (58,59). Key socioeconomic factors influencing the risk of PIH includes: education, access to healthcare, income and employment (57). Hypertension, most especially PIH used to be high in industrialized countries, but now developing countries contribute nearly twice as much as industrialized countries to the global cardiovascular diseases (31). Few studies have examined the association between socioeconomic status and PIH, and these studies found contradictory results. Some have found poor socio-economic circumstances around the time of pregnancy to be positively associated with PIH, another study found an inverse association with higher rates among the better off, and other studies have found no association (31,41,60). In developed countries, people with high socio-economic status adopt life styles that help to lower cardiovascular diseases and received

better treatment (8,61). A study conducted in Sweden found an adjusted risk ratio of 1.25 for developing pre-eclampsia among women in the lowest income quintiles compare to those in the highest income quintile (59). Poverty is associated with reduce awareness, treatment and control of hypertension. PIH, therefore, has a high prevalence in low socio-economic status groups (7,43). Low-income groups lack access to facilities and services, and live in constant socio-economic stress (1). The higher the socio-economic resources a person has, the more likely they are to see a doctor for preventive examination which enhances their quality of life. Those with low-income status tend to eat more fat and processed food because it is less expensive (11,13).

Low socio-economic status is associated with hypertension, therefore, there is need to develop and test cultural-approach interventions, in order to reduce the prevalence of hypertension among these populations and minimize the resultant risk, morbidity and mortality (14,16). Sub-Saharan Africa has different ethnic groups and culture. In these countries with different socio-economic status, PIH is common with urbanized people than rural people, who are protected (10,24,62). This is due to obesity, dietary excess, alcohol consumption and lack of exercise which is common in urban areas (45). The socio-economic background is often intertwined with cultural with cultural and regional factors that can further

aggravate the risk associated with PIH. For example, immigrant women or those from marginalized communities may face additional barriers to healthcare services, leading to increase rates of pregnancy hypertension disorder (59).

2.3 Nutrition, and Lifestyle Factors and PIH

Lifestyle choices significantly influence the risk of developing PIH. Factors such as diet, physical activity, and sleep management are crucial in determining maternal health outcomes (63,64). Studies shows that intake of protein, carbohydrate, fat, saturated fatty acids, vitamin A, D, K, calcium, iron, copper, selenium and manganese are not associated with the risk of PIH. Whereas high intake of energy, mono saturated fatty acids, poly unsaturated food with higher intakes of vitamins, potassium and magnesium are associated (65,66). A study with 134 pregnant women reveals that weight loss, reduces blood pressure (BP) by 15%. It is against such background that PIH women need to be equipped with adequate knowledge, skills to subsequently self-care and how to avoid excess weight gain during gestation (7).

Diet such as fruits vegetables and low-fat dairy products that includes whole grains, fish and nuts that contain decrease amount of total fats and saturated fat and cholesterol lowers blood pressure substantially in women with PIH (67,68). Well established dietary modification that lower blood pressure are reduced fat

and calorically dense foods, low salt intake, weight loss and moderation of alcohol consumption among women who drink (66,68).

According to Mayo clinic (University of Maryland Medical Center), a poor diet cause PIH. The university of Maryland medical center recommends cutting back on process foods and refined sugar, and cutting out caffeine, alcohol and any medication that are not prescribed by doctor can help the risk of developing hypertension (20). Positive lifestyle, changes such as limiting the intake of salt, participating in regular physical activity and losing weigh if overweight are helpful in regulating and keeping a healthy diet and blood pressure (14,66). A randomized control study was conducted in South Africa on 15,528 women to assess whether the calcium supplementation will reduce the risk of hypertensive disorders. The results shows that High blood pressure was reduced with calcium supplementation rather than placebo in 14,946 women (95%) (7,66,69). A study conclude that calcium supplementation appears to reduce the risk of pre-eclampsia and to reduce the rare occurrence of the complicated maternal outcome like death and serious morbidity (65).

2.4 Family History of Hypertension and PIH

Family history is a well-established risk factor for hypertension, and it plays a significant role in the development of PIH. Women with a family history of

hypertension are more likely to experience elevated blood pressure during pregnancy. This aligns with other literatures that have constantly shown high risk among women with hypertensive relatives (70). Understanding familial patterns of hypertension can help healthcare providers predict, identify at-risk individuals and implement early interventions (36,63). Other studies encourage healthcare providers to probe and asses women's family history of hypertension during routine prenatal visits. This strategy can help identify women at higher risk and enhance an ideal monitoring and interventions for positive maternal and fetal outcomes (32,36,44). Family history influence both prevalence and severity of PIH. Veiga, E.C.A., et al. (2020) conducted a systematic review and meta-analysis that revealed women with a family history of hypertension are at a higher risk of developing PIH, stressing the hereditary or genetic tendency associated with PIH (71). Recognizing family history of hypertension as a risk factor of PIH, health care provider can devise strategies like lifestyle modifications, regular health screenings, monitor, and manage at risk populations effectively in order to mitigate the risk of developing the condition (71,72).

A study in Shanghai, China indicated that individuals with family history of hypertension had s significantly higher risk of developing hypertension than those individuals of normotensives, with an odds ratio of 4.103. The same study also

reported an odds ratio of 16.537 for the interaction between family history and diabetes, which significantly increased the risk of hypertension when family history of hypertension and diabetes combined (73). Another study established that family history plays a pivotal role in hypertension, showing progenies of hypertensive parents exhibit reduced heart rate variability, which is associated with an increased risk of hypertension compared to those progenies of normotensives (17).

Chapter III Method and Materials

3.1 Study Design

This study employed a Case-Control Study design, looking at the prevalence and associated factors of PIH among pregnant women in the Upper River Region (URR) of The Gambia. The case-control approach is appropriate for this research as it allows for the comparison of women with PIH (cases) to those without (controls), facilitating the identification of risk factors associated with the condition.

Study participants consist of cases and controls from the seven (7) districts within the region. The prevalence of the condition in the region, which is the descriptive component was centered around a six-year period: 2019-2024 secondary data record review on Pregnancy-Induce Hypertension from the national District Health Information System 2 (DHIS2), Health Management Information System (HMIS), Ministry of Health. The prevalence of PIH was determined as the number of pregnant women with PIH in the URR divided by the total number of pregnant women population of the region and the associated factors, the analytical component of the condition were obtained from a primary data collection method, through the administration of structured and semi-structured questionnaires to

pregnant women with PIH (cases) and normotensive pregnant women (controls) attending Reproductive, Maternal, Neonatal Child and Adolescent Health (RMNCAH) clinics in the Upper River Region. Cases and controls were matched by age, and gravid to ensure comparability.

3.2 Variables

3.2.1 Dependent Variables

The dependent variable in this study is Pregnancy Induced- Hypertension (PIH), classified as the elevation of the arterial blood pressure after the twentieth (20^{th}) week of gestation, going above the normal reading of 140/90mmHg.

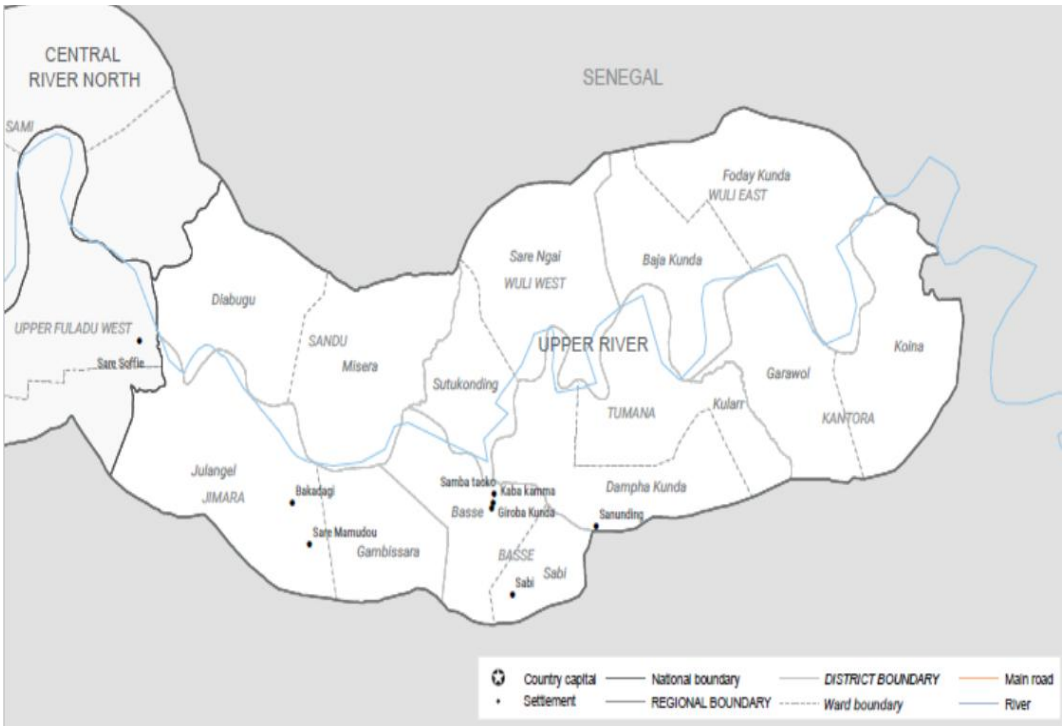
3.2.2 Independent Variables

The independent variables are factors that are hypothesized to be associated with the occurrence of Pregnancy Induced- Hypertension (PIH). These independent variables included: socio-demographics (age, marital status etc.), health and pregnancy history (maternal age, previous pregnancy history etc.), lifestyle, nutrition and environmental factors that are potential associated with PIH.

3.3 Study Area and Population

The study was carried out in the seven (7) districts (Basse, Wuli West, Wuli East, Sandu, Kantora, Tumana and Jimara) of the eastern part of The Gambia, Upper

River Region. This region is the third most populated region in the country with an estimated population of 314,610 including pregnant women population of 11,955 (74). The region has 11 public health facilities, across the seven districts that render antenatal services to pregnant women at Reproductive, Maternal, Neonatal Child and Adolescent Health (RMNCAH) clinics, which are either facility-based clinics or outreach clinics. Given that the study area is an urban settlement, the target population was representative of the larger population of pregnant women population of the region as selected pregnant women had varied socio-demographic, lifestyles, nutrition, health and pregnancy history.



Source:https://www.unocha.org/publications/map/gambia/gambia-upper-river-assessment-region-reference-map-16-august-2022

Figure-3.1: Showing the map of the study area, Upper River Region.

3.4 Study Participants

The study participants were pregnant women of child bearing age (15 – 49 years) in the Upper River Region attending Reproductive, Maternal, Neonatal Child and Adolescent Health (RMNCAH) clinics. A matched sampling of 1:1 was used, where for each case identified, a control is recruited. Matched on key variables such as age and gravida status to ensure that the comparison is valid and to reduce cofounding factors.

3.4.1 Inclusion Criteria

Cases: Pregnant women within the age of 15 – 49 years willing to participate in the study, residing in Upper River Region, attending RMNCAH clinic at the time, and having an elevated blood pressure ≥ 140/90mmHg on two different readings during routine antenatal care; four (4) hours apart; after 20 weeks of gestation in a normotensive pregnant woman.

Controls: Normotensive Pregnant women with blood pressure of < 140/90mmHg, residing in Upper River Region, that matched an identified case on age and gravida status, willing to participate in the study, and attending RMNCAH clinics.

3.4.2 Exclusion Criteria

Cases: Pregnant women attending the RMNCAH clinics within the region with known chronic diseases that could confound the results like pre-existing Hypertension, gestational diabetes, thyroid disorder, renal diseases and had cognitive impairment or inability to provide necessary information.

Controls: Pregnant women with psychological conditions that may affect their ability to participate in the study or provide informed consent.

3.5 Sampling Techniques

3.5.1 Sampling Size Determination

The sample size for this case-control study was determined using the CDC's Epi Info™ StatCalc (Version 7.2.6.0) adopting the following parameters: 95% two-sided confidence level, 80% power, 5% significance level, odd ratio of 2.36 and expected proportion exposed in controls of 15% (75). The calculated sample size was 131 cases and 131 controls, giving a total of 262 study participants. The sample size was increased to 292 study participants (146 cases and 146 controls) to accounts for the 10% non-response rate from study participants and improve the strength of the study.

3.5.2 Sampling Procedure

Study participants were recruited from August 12th to September 20th at all seven (7) districts in the Upper River Region, by visiting Reproductive, Maternal, Neonatal Child and Adolescent Health Clinic in these districts. Districts conduct both based and outreach RMNCAH clinics depending on each district's schedule, operating from 8 a.m to 16 p.m. Matched sampling was used at the RMNCAH clinics in which pregnant women between the age cohort of 15 - 49 years who presented with an elevated blood pressure of ≥140/90MmHg on two different reading and after the 20th week of gestation were recruited as cases. While the controls are comparable pregnant women from the same population with a normal blood pressure reading of <140/90MmHg and match cases based on age and gravida variables. A total of 146 cases and 146 controls were recorded during this period of data collection.

3.6 Data Collection Procedures

3.6.1 Selection and Training of the Research Assistants

In the data collection process, five (5) research assistants were recruited. They were chosen from health facilities within the region; they were all trained health care providers, and were fluent in both English and at least two (2) from the three (3) dominant local languages (Fula, Mandinka, and Sarahuleh) in the region. The research assistants underwent comprehensive training on the study's purpose, objectives, and methodology by the principal investigator. This included a thorough review of the questionnaire, how to probe for additional information when necessary to ensure completeness and clarity and guidance on standardized interviewing techniques. Questionnaire was then pre-tested on a small sample of participants by research assistants in order to expose them on how to conduct interviews; the responses were recorded by the principal investigator, allowing for necessary adjustments on any ambiguities or issues before full deployment.

3.6.2 Data Collection Techniques and Tools

The principal investigator got secondary data from the national District Health Information System 2 (DHIS2), HMIS database; for six years periods (2019-2024) and also joined research assistants in the field to conduct face-to-face interviews with study participants on structured and semi- structured questionnaire that

includes demographic information, socioeconomic status, health and pregnancy-related history, lifestyle, nutrition, family history of hypertension and specific variables pertinent to the study's objectives.

An electronic open-source platform called Kobo Toolbox was used for collecting, managing and visualizing primary data from the study groups. This questionnaire was inputted in the electronic toolbox for data collection. Skip patterns were used to standardize the questionnaire, so as to avoid repetition of questions. Throughout the data collection phase, the principal investigator monitored the process closely to ensure adherence to the protocol and to address any challenges encountered by the research assistants; likewise ensuring a comfortable and culturally sensitive environment. Secondary data was extracted from the national DHIS2-HMIS database by downloading the Microsoft excel version of the data for easy analysis.

3.6.3 Validity and Reliability

Literatures related to this study were reviewed and the concept used in this research is the first of its kind in the URR of the country. Validated questionnaires were adopted from previous researches and World Health Organization. The questionnaires were then reviewed by thesis supervisor for construct and content validity. A small pilot study (pre-test) was conducted to test the feasibility of the questionnaire, test for validity and reliability before the study begins, and

identify any issues before full-scale data collection. Adopting the electronic Kobo Toolbox strictly help reduces the possibility of human error in data entry, minimize the risk of data loss, and improve accuracy by allowing for real-time data validation. To ensure the geographic representativeness of the study, data collection was conducted across multiple sites in the region. The GPS coordinates of these were recorded and displayed in maps. This ensures precise documentation of data collection sites, reduce errors and enhance the reproducibility of the study.

Throughout the data collection phase, the principal investigator closely monitored the process to ensure adherence to the protocol, periodic checks made to ascertain completeness, verify accuracy and consistency in the collected data, and address any challenges encountered by the research assistants. Data were later cleaned and validated to ensure accuracy before proceeding with statistical analysis.

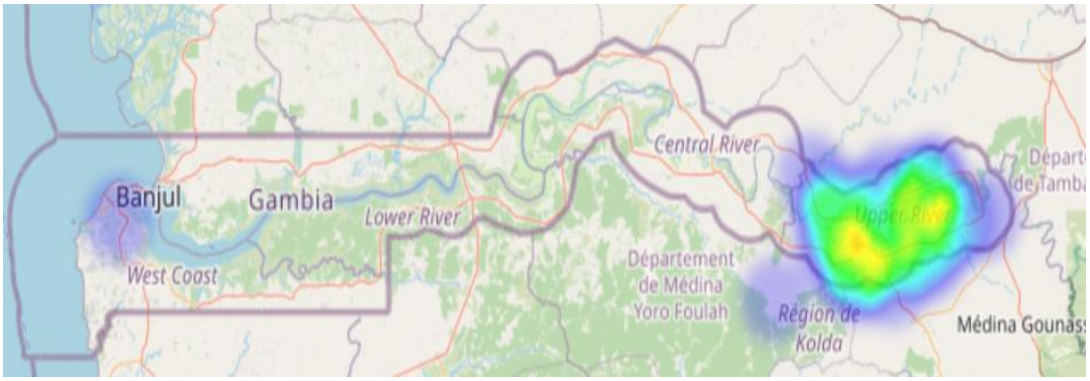


Figure-3.2: Showing GPS coordinates of the Upper River Region (URR) of The Gambia.

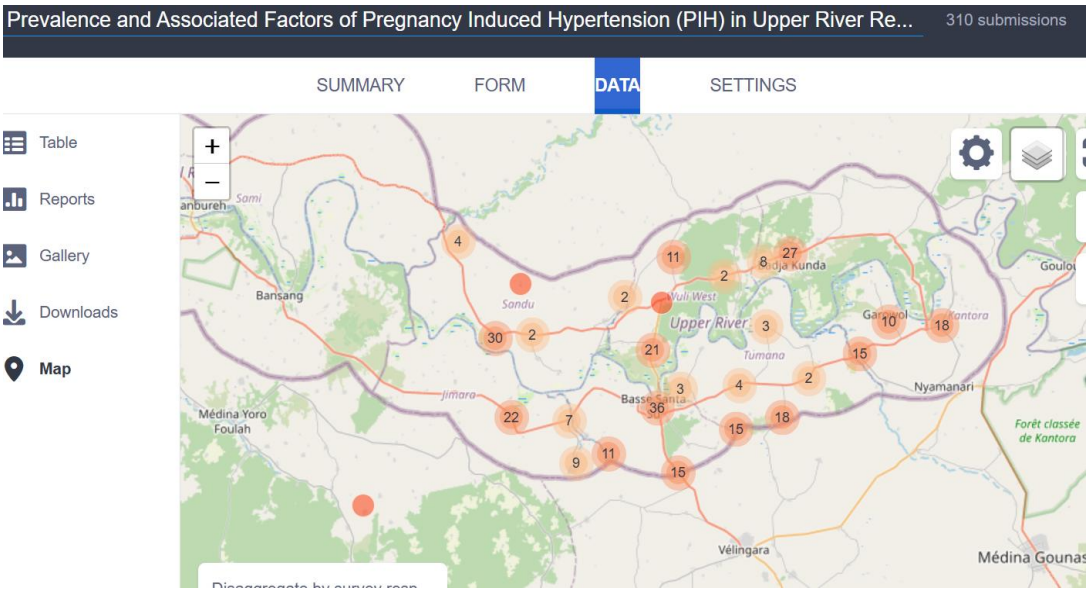


Figure-3.3: Geographic distribution of data collection sites in the Upper River Region showing GPS coordinates.

3.7 Data Management and Analysis

Data from this study were then downloaded from the Kobo Toolbox in a Microsoft Excel format and imported into Statistical Package for Social Sciences (SPSS) software version 25 for analysis. The data was checked, compiled coded, and cleaned in line with research variables.

We analyzed data using SPSS version 25 and Microsoft Excel. Results were presented in form of geographical map, frequency tables, bar charts and graphs, based on numbers, frequencies and percentages. To give characteristics of variables descriptive statistics, frequencies, and percentages were calculated. Independent Sample T-test, Chi-Square test and binary logistic regression were used to establish significant association between dependent and independent

variables. In general, statistical significance was assumed at $p<0.05$ and at 95% Confidence Interval (CI).

3.8 Ethical Consideration

Permission was sought from National Research Ethic committee, by applying with the clearance obtained from Southern Medical University; School of International Education. Clearance was also obtained from the Regional Health Directorate (RHD), URR; that was filtered down to all Officers In-Charge of health facilities within the seven (7) districts of the region. Study protocol and ethic's guidelines were well observed during the course of this study.

Study participants consent was sought verbally. They were informed about the study's objectives, the nature of the study, what they were supposed to do during the process and have the right to be enrolled for the study or withdraw from the study without any consequences. Confidentiality of all the subjects were assured and maintained during and after the study.

Chapter IV Results

The results of this study give a comprehensive synopsis of the prevalence and associated factors of PIH in the URR of The Gambia. This chapter presents the results derived from the analysis of secondary data collected from the DHIS2 over the past six years and primary data from study participants, including the trends of PIH across the country's seven health regions, with specific emphasis on URR and its seven districts. Additionally, the results of statistical analyses, including Independent Sample T-Tests, Chi-Square tests, and both Univariate and Multivariate Binary Logistic Regression, are presented to explore the factors associated with PIH. The following sections of this chapter will show the graphic trend and tabulated results, accompanied by their respective interpretations, to provide a clear understanding of the pattern and determinants of PIH in the region.

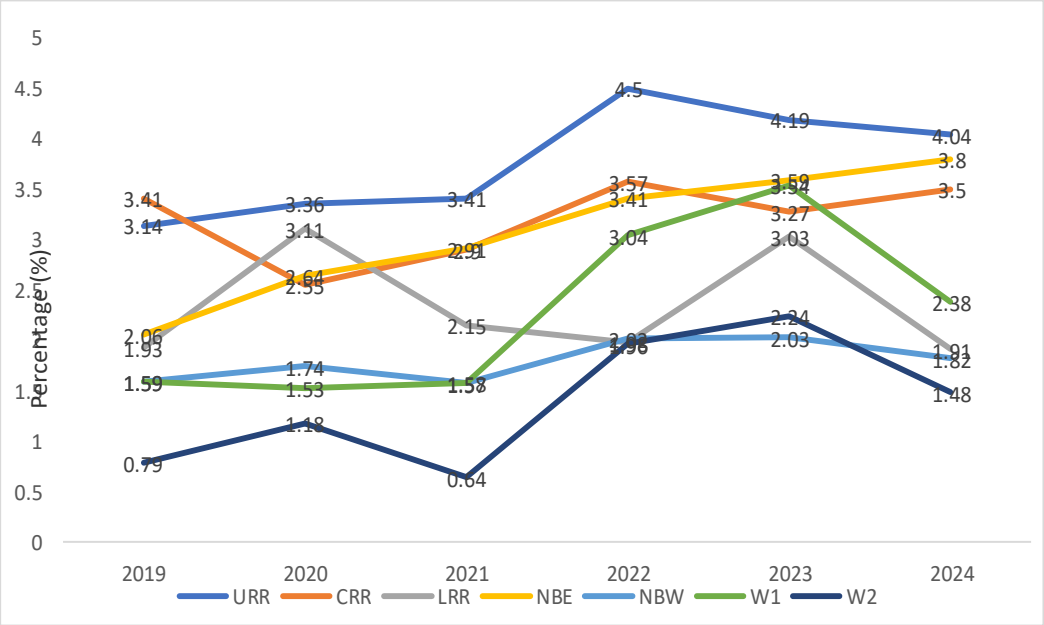
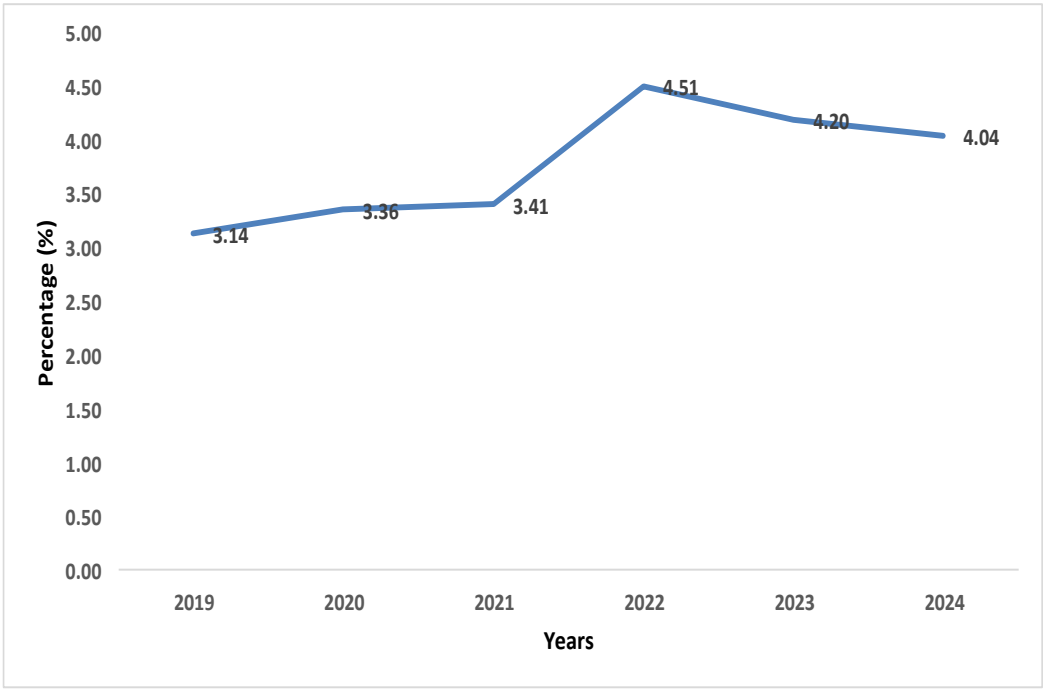


Figure 4.1 Showing the trend of PIH in the 7 health regions of The Gambia from 2019-2024

This line graph above depicting the trend of PIH across the 7 health regions of The Gambia from 2019 to 2024 shows diverse trends among the regions. The Upper River Region (URR) had an increase of cases from 2019-2022 and starts decreasing slightly from 4.5 in 2022 to 4.19 in 2023 and remains relatively stable at 4.04 in 2024. In 2019 the Central River Region (CRR) had the highest prevalence of PIH, 3.41 compared to other regions and later dropped to 2.44 in 2020. There was a decreased from 3.57 to 3.27 in 2023 before jumping up slightly to 3.50. The Lower River Region (LRR) showed a sharp increase of cases from 2019 to 2020 and from 1.98 in 2022 to 3.03 in 2023, then followed a huge drop to 1.91 in 2024. Notably, the North Bank East (NBE) continue to display an increase in all the years from 3.41 in 2022 to 3.59 in 2023 and recently a rise to 3.80, while North Bank West (NBW) had a prevalence of less than 2.0 from 2019-2021 and was steady from 2022 to 2023 showing 2.02 and 2.03 respectively then dropped to 1.82 in 2024.The Western One Region (W1) also showed a lower prevalence of less 2.0 from 2019-2021, then a sharp increase in 2022 to 3.04 and 3.54 in 2023, then dropped to 2.38 in 2024 and Western Two Region (W2) likewise displays a consistent rise from 1.96 in 2022 to 2.24 in 2023, but later drop to 1.48 in 2024. Overall, the data indicates how the trend of PIH changed from 2019 to 2024 across the regions. The

prevalence of PIH was seen fluctuating in the health regions, URR hit more compared to other regions, even though the region is experiencing some drop down in cases. Likewise, NBE is also challenged as this region experienced rises across years. In 2023, five of the regions exhibit upward trend, highlighting the need for appropriate health intervention in these specific areas and in 2024 only NBE and CRR experienced an upward trend, while the other regions show a gradual decline. This investigation could help policymakers find regions needing more health interventions and resources.



Years	2019	2020	2021	2022	2023	2024
PIH Cases	330	362	377	512	489	483
Pregnant Women Pop.	10,515	10,789	11,069	11,357	11,652	11,955

Figure 4.2 Showing the trend of PIH in the Upper River Regions of The Gambia from 2019-2024

The graph above is showing the trend of PIH in the Upper River Region from 2019 to 2024, providing relevant results to this study on the prevalence and associated factors of PIH in the region. The regional prevalence experienced a gradual increase from 3.14 to 3.36 in 2020 and the trend continued upward to 3.41 in 2021, indicating a sluggish but stable rise in cases in the region. A significant peak was

observed in 2022, where prevalence surged sharply to 4.41, suggesting possible contributing factors or health issues that may have intensified during this year. However, this followed by a decline to 4.20 in 2023 and a slight decline to 4.04 in 2024. This trend indicates variations in prevalence over the years, emphasizing the need for thorough investigation to the possible factors contributing to these changes and the employment of ideal interventions that can improve maternal health outcomes in the region.

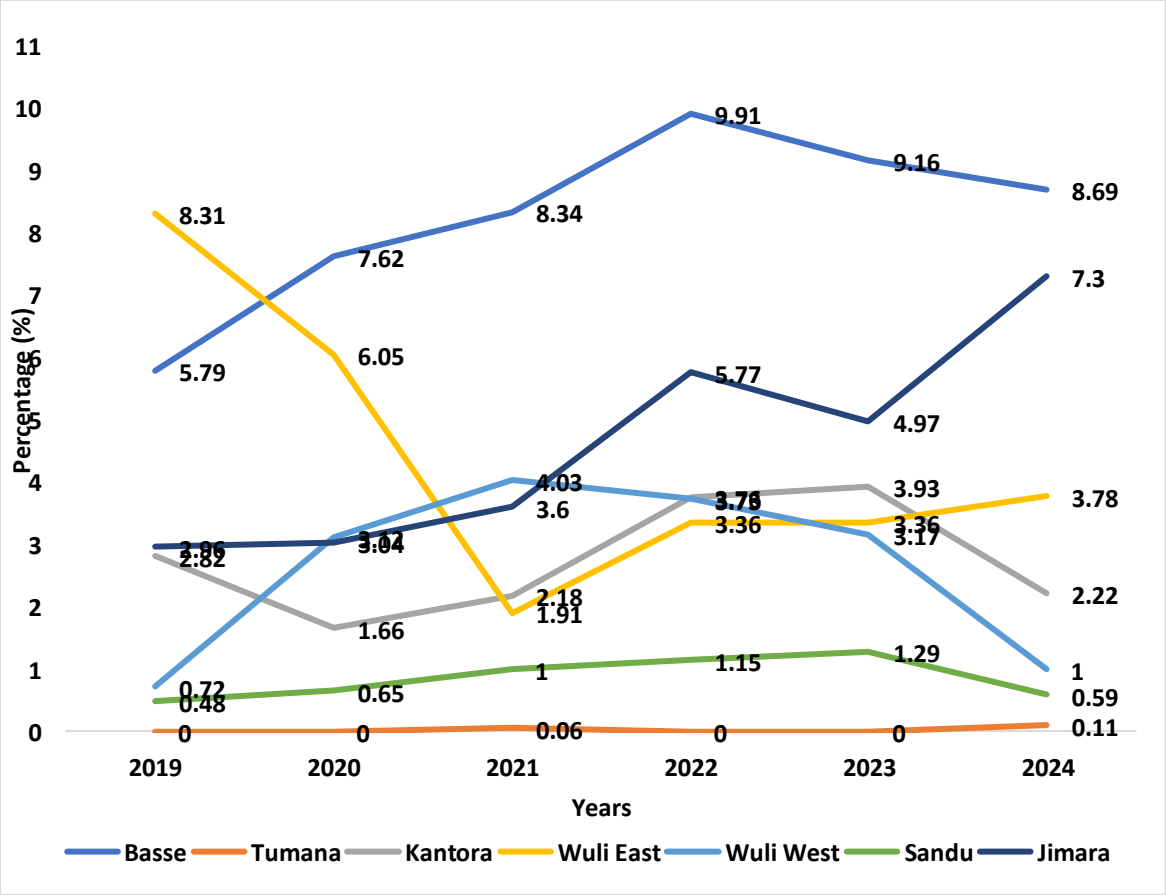


Figure 4.3 Showing the trend of PIH in the 7 districts of Upper River Regions, The Gambia from 2019-2024

The seven (7) districts of the Upper River Region's line graph above illustrated the trend of PIH from 2019 to 2024, revealing differences in prevalence. Basse consistently maintained the highest prevalence among the districts, which could be associated to the district extension of health services to Tumana district, being the regional referral hospital and the most populated district. From 2019 to 2022, Basse displayed an increase of cases yearly and a mild drop in 2023 and 2024, likewise

Sandu and Jimara experienced the same trend of upsurge of case from 2019 to 2022 then a decline the following years. Jimara though had a spike in 2024 from 4.97 in 2023 to 7.3 in 2024, reflecting a growing prevalence of PIH in this district. Kantora exhibited fluctuations, with a peak of 3.93 in 2023 before declining to 2.22 in 2024. Wuli East displayed high prevalence in 2019 with 8.31 and 6.05 in 2020, then a sharp decline (1.91) in 2021 and an upsurge of cases again in 2022 and 2023 at 3.36 prevalence for both years plus a gradually increased of cases to 3.78 in 2024. Wuli West saw a rise from 0.72 to 4.03 in 2021, but dropped to 1.00 in 2024. Tumana had the lowest prevalence throughout the period, which could be due to the district lack of health facility previously. This district's inhabitants were seeking health services at Basse and Kantora, until of recent when they got a health facility. Overall, the trends indicate significant disparities in PIH across the districts, stressing the need for targeted health interventions and resources, mainly in high prevalence areas like Basse and Jimara.

Table 4.1: Independent Samples T-Test Results Comparing Cases and Controls in the study of Pregnancy Induced-Hypertension (PIH) in the Upper River Region, The Gambia.

Variables	PIH Status			
	Cases **(n=146)** **(Mean±SD)**	Controls **(n=146)** **(Mean±SD)**	**t-Value**	**P-Value**
Age in Years	29.56±7.433	29.97±7.625	-0.466	0.805
Gravida	4.55±2.848	4.53±2.848	0.062	0.807
Gestational Age in Weeks	**23.24±8.623**	**24.67±6.743**	**-1.580**	**0.001**
Weight Before Pregnancy (kg)	**64.38±13.265**	**60.49±9.209**	**2.911**	**<0.001**
Current Weight (kg)	**69.21±15.348**	**64.80±9.505**	**2.948**	**<0.001**
Height (cm)	169.11±8.325	169.07±8.966	0.041	0.532
No. of PIH Diagnoses	**2.36±1.610**	**1.43±0.535**	**1.523**	**0.011**
Hours of Physical Activity	1.60±0.889	1.66±1.042	0.453	0.614
Hours of Sleep	8.1421±0.99434	8.0582±0.92710	0.746	0.162

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The findings of the Independent Sample T-Test in Table 4.1 presented a detailed comparison of important characteristics between the study's cases and controls group in order to explore the prevalence and contributing factors of PIH in the Upper River Region. Significant differences in several variables were shown by this analysis, which improves our understanding of the key factors influencing the

research's findings.

There were 292 participants in all, 146 of whom were cases and 146 of whom were controls. Comparing cases and controls on this Independent Sample T-Test, the result shows that there was slight mean difference (Mean±SD) of age for cases and control as 29.56±7.433 and 29.97±7.625 respectively, and there is no significant difference in age (p=0.805) indicating that age may not be a strong factor in the prevalence of PIH in this Study population as age was one of the variables matched among cases and controls. However, the mean difference of gestational age, weight before pregnancy, current weight and number of PIH diagnoses were statistically significant. The means and standard deviations were 23.24±8.623 and 24.67±6.743; p=0.001(gestational age), 64.38±13.265 and 60.49±9.209; p<0.001 (weight before pregnancy), 69.21±15.348 and 64.80±9.505; p<0.001 (current weight) and 2.36±1.610 and 1.43±0.535; p=0.011 (number of PIH diagnoses) for cases and controls respectively. Highlighting that gestational age, number of times a women had PIH, weight pre-pregnancy, and during pregnancy is associated with PIH. There was also no significant difference in terms of gravida (p=0.807), which was also a matched variable among cases and controls. Height with a p-value of 0.532, hours in physical activity (p=0.614), and hours of sleep (p=0.162) are not significant, suggesting it may not be a key factor of PIH in this context.

Table 4.2: Comparison of Socio-Demographic Characteristics Between Cases and Controls in the Study of Pregnancy-Induced Hypertension (PIH) in the Upper River Region, The Gambia: Chi-Square Test Results.

Characteristics	PIH Status				
	Case = 146 n (%)	Control = 146 n (%)	Total = 292 n (%)	χ^2	P *value*
Age Group				0.000	1.000
15 -24 Years	43 (29.5%)	43 (29.5%)	86 (29.5%)		
25 - 34 Years	63 (43.2%)	63 (43.2%)	126 (43.2%)		
35 - 44 Years	36 (24.7%)	36 (24.7%)	72 (24.7%)		
45 - 49 Years	4 (2.7%)	4 (2.7%)	8 (2.7%)		
Marital Status				2.014	0.365
Single	2 (1.4%)	0 (0.0%)	2 (0.7%)		
Married	143 (97.9%)	145 (99.3%)	288 (98.6%)		
Divorced	1 (0.7%)	1 (0.7%)	2 (0.7%)		
Educational Status				1.586	0.453
Non-Formal	66 (45.2%)	69 (47.3%)	135 (46.2%)		
Lower Education	42 (28.8%)	33 (22.6%)	75 (25.7%)		
Higher Education	38 (26.0%)	44 (30.1%)	82 (28.1%)		
Occupation				0.203	0.652
House Wife	143 (97.9%)	144 (98.6%)	287 (98.3%)		
Working Woman	3 (2.1%)	2 (1.4%)	5 (1.7%)		
Ethnicity				3.659	0.454
Fula	42 (28.8%)	49 (33.6%)	91 (31.2%)		
Mandinka	54 (37.0%)	55 (37.7%)	109 (37.3%)		
Sarahuleh	50 (34.2%)	40 (27.4%)	90 (30.8%)		
Wollof	0 (0.0%)	1 (0.7%)	1 (0.3%)		
Others	0 (0.0%)	1 (0.7%)	1 (0.3%)		
Monthly Household Income				**10.583**	**0.014**
D1,000 < D5,000	20 (13.7%)	25 (17.1%)	45 (15.4%)		
D5,000 < D10,000	64 (43.8%)	73 (50.0%)	137 (46.9%)		
D10,000 < D15,000	38 (26.0%)	41 (28.1%)	79 (27.1%)		
≥ D15,000	24 (16.4%)	7 (4.8%)	31 (10.6%)		

Gravida Range				0.000	1.000
Prime	26 (17.8%)	26 (17.8%)	52 (17.8%)		
2 - 5 Gravida	68 (46.6%)	68 (46.6%)	136 (46.6%)		
6 - 9 Gravida	42 (28.8%)	42 (28.8%)	84 (28.8%)		
≥ 10 Gravida	10 (6.8%)	10 (6.8%)	20 (6.8%)		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The analysis on Table 4.2 on demographic and socio-economic characteristics between cases of PIH and controls in the URR revealed no significant differences across variables. There was no significant difference (p=1.000) on the age of study participants after the age was categorically grouped, likewise on the gravida (p=1.000) after it was also categorized into groups. These two variables were the matched variables for a control to a case and no difference was expected. A noteworthy finding was observed, when the highest prevalence of cases was recorded in the 25–34-year age group, comprising (n=63), 43.2% of the total case, 15-24 years were 29.5% (n=43), 35-44 years were 24.7% (n=36) and 45-49 years were 2.7% (n=4) indicating more than half of cases were around the ages of 15 years to 34 years. Household monthly income is a relevant contributor to the risk of PIH, as shown by the significant association (p=0.014) that suggested lower-income brackets had a higher representation 15.4% and 46.9% for D1,000 < D5,000 and D5,000 < D10,000 respectively. 13.7% (n=20) of the cases earn around D1,000 < D5, 000 monthly, 43.8% (n=64) of the cases earn around D5,000 <

D10,000 monthly, 26.0% (n=38) of cases earn around D10,000 < D15,000 monthly and just 16.4% (n=24) earn around D15,000 and above. More than half of all the cases earn less than D10,000 monthly.

The Majority of the study participants were married (n=288), 98.6%, with no significant differences noted between cases and controls (p=0.365). 97.9% (n=143) of cases were married, 1.4% (n=2) were single, and only one participant (0.7%) from cases group and one participant (0.7%) from control group were divorced and 99.3% (n=145) of controls were married. Ethnicity of these study population shows no significant differences (p=0.454), indicating that the incidence of PIH was evenly distributed among ethnic groups. Majority of cases 37.0% are Mandinka, 34.2% are Sarahule, 28.8% are Fula while for the controls 37.7% are Mandinka, 33.6% are Fula and 27.4% are Sarahule, and a small fraction are Wollof or others. Educational attainment likewise, did not show significant differences (p=0.453), suggesting that education level may not be a strong risk factor for PIH in this study population, even after seeing more than half of the study participants had formal education and only 46.2% (n=135) had non-formal education. About 28.8% (n=42) of cases had lower education, 26.0% (n=38) of cases had higher education and 45.2% (n=66) of cases had no formal education while 22.6% (n=33) of controls had

lower education, 30.1% (n=44) of controls had higher education, and 47.3% (n=69) of controls had no formal education.

Similarly, the study population in both groups 98.3% (n=287) were housewives, with no significant differences (p=0.652), suggesting that occupation did not play a significant role in the prevalence of PIH. 97.9% (n=143) of cases were housewives, 2.1% (n=3) were working class women while 98.6% (n=144) of controls were housewives and 1.4% were working class women. The number of pregnancies one has had may not significantly affect the likelihood of developing PIH in this study population of the region, as evidenced by the lack of significant differences (p=1.000) between the two groups when gravida for cases and controls was sorted out categorically. 46.6% (n=136) of the study participants were within 2-5 gravida and 28.8% (n=84) were within 6-9 gravida.

Table 4.3: Comparison of Health and Pregnancy History Between Cases and Controls in the Study of Pregnancy-Induced Hypertension (PIH) in the Upper River Region, The Gambia: Chi-Square Test Results.

Characteristics	**PIH Status**				
	Case = 146 **n (%)**	**Control = 146** **n (%)**	**Total =292** **n (%)**	χ^2	**P *value***
Gestational Age in Weeks				**15.939**	**<0.001**
First Trimester	28 (19.2%)	7 (4.8%)	35 (12.0%)		
Second Trimester	45 (30.8%)	64 (43.8%)	109 (37.3%)		
Third Trimester	73 (50.0%)	75 (51.4%)	148 (50.7%)		
Previously had PIH				**76.695**	**<0.001**
Yes	74 (50.7%)	7 (4.8%)	81 (27.7%)		
No	72 (49.3%)	139 (95.2%)	211 (72.3%)		
Family History of Hypertension				0.225	0.635
Yes	87 (59.6%)	83 (56.8%)	170 (58.2%)		
No	59 (40.4%)	63 (43.2%)	122 (41.8%)		
Have chronic health conditions				**34.834**	**<0.001**
Yes	51 (34.9%)	10 (6.8%)	61 (20.9%)		
No	95 (65.1%)	136 (93.2%)	231 (79.1%)		

Medical supervision				**5.378**	**0.020**
Yes	44 (30.1%)	27 (18.5%)	71 (24.3%)		
No	102 (69.9%)	119 (81.5%)	221(75.7%)		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The result presented in Table 4.3 above highlighted a significant difference in health and pregnancy history between cases of PIH and control in the region. Notably, there is a marked difference in gestational age after sorting the gestational age categorically, with a higher percentage of cases 50.0% (n=73) are in their third trimester, 30.8% (n=45) in their second trimester, 19.2% (n=28) in the first trimester compared to controls 51.4% (n=75), in the third trimester, 43.8% (n=64) in the second trimester, 4.8% (n=7) in the first trimester. PIH may be more prevalent as pregnancies progress to the third stage of pregnancy and a statistically difference ($p<0.001$) between cases and control. A prominent finding is the prevalence of previous pregnancies complicated by PIH; 50.7% (n=74) of cases reported such a history, in contrast to only 4.8% (n=7) of controls reported such a history, indicating a strong association ($p<0.001$) between prior PIH and the likelihood of experiencing it in subsequent pregnancies. Family history of hypertension did not show a statistically significant difference ($p=0.635$) between groups, 59.6% (n=87) of cases reported it and 56.8% (n=83) of controls reported,

indicating that family history may not be a decisive factor in this context, even though it is a known risk factor. However, there was a significant association between having a chronic health condition and PIH, with 34.9% (n=51) of cases having been diagnosed with chronic health issues compared to only 6.8% (n=10) of controls ($p<0.001$), indicating that pre-existing health issues are a major risk factor for developing PIH. Furthermore, a significant proportion of cases 30.1% (n=44) were at the time of the study under medical supervision for health conditions, compared to 18.5% (n=27) of controls ($p=0.020$), suggesting that being under regular medical supervision could help in better managing pregnant women at risk or diagnosed with health condition that might contribute to PIH.

Table 4.4: Comparison of Antenatal Care (ANC) Attendance and Lifestyle Factors Between Cases and Controls in the Study of Pregnancy-Induced Hypertension (PIH) in the Upper River Region, The Gambia: Chi-Square Test Results.

Characteristics	**PIH Status**				
	Case = 146 n (%)	**Control = 146 n (%)**	**Total =292 n (%)**	**χ^2**	**P *value***
ANC attendance				2.014	0.365
Weekly	1 (0.7%)	0 (0.0%)	1 (0.3%)		
Bi-Weekly	1 (0.7%)	0 (0.0%)	1 (0.3%)		
Monthly	144 (98.6%)	146 (100.0%)	290 (99.3%)		
Smoking					
No	146 (100.0%)	146 (100.0%)	292 (100.0%)		
Alcohol Intake					
No	146 (100.0%)	146 (100.0%)	292 (100.0%)		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The results from Table 4.4 regarding ANC attendance or prenatal check-ups during gestation reveal no significant differences between the cases of PIH and the control group. Both groups predominantly attended prenatal check-ups on a monthly basis, indicating that ANC attendance pattern are similar regardless of PIH status; with (n=144) 98.6% of cases and (n=146) 100% of controls adhering to this schedule. The other two cases, one was attending it weekly and the other was attending Bi-weekly. This was due to the extreme elevation of their blood pressure, warranting the healthcare providers to put them on these schedules for close monitoring of their conditions. This suggests that regular prenatal care was equally

accessed by cases and controls, stressing the importance of consistent prenatal monitoring regardless of PIH status and indicating that access to ANC is not a barrier in this study population. Just a small percentage of study participants attended ANC on bi-weekly or weekly, demonstrating that there is no significant difference ($p=0.365$) between the hypertensives and the normotensives. Regarding lifestyle factors, both cases of PIH and controls exhibit similar behaviors on smoking and alcohol consumption, with 100% of study participant in both groups reporting no use of either substance. The absence of smoking and alcohol consumption indicates a potentially positive health-conscious among cases and controls group, showing that lifestyle factors related to smoking, and alcohol is not significantly different between those with PIH and those without. Likewise, these lifestyle choices may not be key contributors to the development of PIH in this population.

Table 4.5: Comparison of Nutritional Factors Between Cases and Controls in the Study of Pregnancy Induced-Hypertension (PIH) in the Upper River Region, The Gambia: Chi-Square Test Results.

Characteristics	PIH Status				
	Case = 146	Control = 146	Total =292		
	n (%)	n (%)	n (%)	χ^2	P-V*alue*
Rice Intake				0.359	0.549
1-2 Times Per Day	86 (58.9%)	91 (62.3%)	177 (60.6%)		
3-4 Times Per Day	60 (41.1%)	55 (37.7%)	115 (39.4%)		
Wheat Flour Intake				1.864	0.394
Don't Take	1 (0.7%)	3 (2.1%)	4 (1.4%)		
1-2 Times Per Day	117 (80.1%)	109 (74.7%)	226 (77.4%)		
3-4 Times Per Day	28 (19.2%)	34 (23.3%)	62 (21.2%)		
Fruits Intake				1.174	0.556
Don't Take	72 (49.3%)	68 (46.6%)	140 (47.9%)		
1-2 Times Per Day	74 (50.7%)	77 (52.7%)	151 (51.7%)		
3-4 Times Per Day	0 (0.0%)	1 (0.7%)	1 (0.3%)		
Vegetables Intake				0.800	0.670
Don't Take	2 (1.4%)	4 (2.7%)	6 (2.1%)		
1-2 Times Per Day	128 (87.7%)	128 (87.7%)	256 (87.7%)		
3-4 Times Per Day	16 (11.0%)	14 (9.6%)	30 (10.3%)		
Processed Food Intake				1.917	0.383

Don't Take	65 (44.5%)	74 (50.7%)	139 (47.6%)		
1-2 Times Per Day	78 (53.4%)	67 (45.9%)	145 (49.7%)		
3-4 Times Per Day	3 (2.1%)	5 (3.4%)	8 (2.7%)		
Red Meat Intake				3.430	0.558
Don't Take	77 (52.7%)	72 (49.3%)	149 (51.0%)		
1-2 Times Per Day	69 (47.3%)	74 (50.7%)	143 (49.0%)		
Fish Intake				4.260	0.119
Don't Take	17 (11.6%)	27 (18.5%)	44 (15.1%)		
1-2 Times Per Day	127 (87.0%)	114 (78.1%)	241 (82.5%)		
3-4 Times Per Day	2 (1.4%)	5 (3.4%)	7 (2.4%)		
Chicken Intake				1.086	0.581
Don't Take	61 (41.8%)	63 (43.2%)	124 (42.5%)		
1-2 Times Per Day	85 (58.2%)	82 (56.2%)	167 (57.2%)		
3-4 Times Per Day	0 (0.0%)	1 (0.7%)	1 (0.3%)		
Eggs Intake				0.129	0.719
Don't Take	56 (38.4%)	59 (40.4%)	115 (39.4%)		
1-2 Times Per Day	90 (61.6%)	87 (59.6%)	177 (60.6%)		
Supplements				1.032	0.310
Yes	140 (95.9%)	143 (97.9%)	283 (96.9%)		
No	6 (4.1%)	3 (2.1%)	9 (3.1%)		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The analysis for nutritional factors for cases of PIH and controls in Table 4.5 indicates that majority of the study participants in both groups consumed rice 1-2 times per day 58.9% (n=86) of cases and 62.3% (n=91) of controls, then by 3-4 times per day 41.1% (n=60) of cases and 37.7% (n=55) of controls. Wheat flour was consumed 1-2 times per day by 80.1% (n=117) of cases and by 74.7% (n=109) of controls, followed by 3-4 times per day by 19.2% (n=28) of cases and by 23.3% (n=34) of controls. Nearly, half of the participants reported not consuming fruits; 49.3% (n=72) of cases and 46.6% (n=68) of controls, while around 50.7% (n=74) of cases and 52.7% (n=77) of controls consumed them 1-2 times per day. More study participants consumed vegetables 1-2 times per day, 87.7% (n=128) of the cases and 87.7% (n=128) of the controls, while about 11.0% (n=16) of the cases and 9.6% (n=49) of the controls take fruits 3-4 times per day. Larger proportion of the study participants reported consuming processed food; 53.4% (n=78) of the cases compare to 45.9% (n=67) of the controls consumed processed food 1-2 times per day. 50.7% (n=74) of the controls compare to 44.5% (n=65) of the cases do not take processed food. The majority of study participants, more than half do not consume red meat; 52.7% (n=77) for cases and about 49.3% (n=72) for controls, while 47.3% (n=69) of the cases and 50.7% (n=74) of controls take red meat 1-2 times per day. Notably about 87.0% (n=127) of the cases and 78.1% (n=114) of the controls

consumed fish 1-2 times per day, which is more than half in each study participant group, then only 11.6% (n=17) of cases and 18.5% (n=27) of controls do not take fish. More than half of the study participant in both groups were reported taking chicken, with around 58.2% (n=85) of the cases and 56.2% (n=82) of controls consumed it 1-2 times per day, and about 41.8% (n=61) of the cases and 43.2% (n=63) of the controls were not consuming chicken. Egg consumption showed some variability, with 61.6% (n=90) of the cases and 59.6% (n=87) of the controls consumed eggs 1-2 times per day, and 38.4% (n=56) of cases and 40.4% (n=59) not eating eggs. A higher percentage of study participants reported taking supplements like irons, calcium and vitamins during the course of pregnancy; 95.9% (n=140) of cases and 97.9% (n=143) of controls.

Overall, the analysis of nutritional factors in the table above reveals no significant differences between cases of PIH and the controls across most food consumption categories, as indicated by p-values consistently above 0.05 for most variables: rice p=0.549, wheat flour p=0.394, fruits p=0.556, vegetables p=0.670, processed foods p=0.383, red meat p=0.558, fish p=0.119, chicken p=0.581, eggs P=0.719 and dietary supplements p=0.310. It is evident that these dietary factors are unlikely to contribute significantly to the prevalence and development of PIH in this study population, as both groups almost have the same dietary choices. These

findings suggest that the overall dietary choices assessed may not play a critical role in the development of PIH within this study population, highlighting the need to explore other potential influences on PIH or for further investigation into other potential risk factors.

Table 4.6: Univariate Logistic Regression Analysis of Factors Associated with Pregnancy-Induced Hypertension (PIH) Among Pregnant Women in the Upper River Region, The Gambia

Variable	Univariate analysis		
	cOR	**(95% CI)**	**P-Value**
Age Group			
45-49 Years	1.000	(0.235, 4.259)	1.000
35-44 Years	1.000	(0.535, 1.870)	1.000
25-34 Years	1.000	(0.578, 1.730)	1.000
15-24 Years	Reference		
Educational Level			
Non-Formal Education	0.903	(0.521, 1.565)	0.716
Lower Education	0.679	(0.362, 1.273)	0.227
Higher Education	Reference		
Household Monthly Income			
D1,000 < D5,000	4.286	(1.535, 11.968)	**0.005**
D5,000 < D10,000	3.911	(1.580, 9.680)	**0.003**
D10,000 < D15,000	3.699	(1.430, 9.571)	**0.007**
≥ D15,000	Reference		
Gravida			
Prime	1.000	(0.357, 2.805)	1.000
2 - 5 Gravida	1.000	(0.391, 2.557)	1.000

6 - 9 Gravida	1.000	(0.377, 2.652)	1.000
≥ 10 Gravida	Reference		
Gestational Age			
Third Trimester	4.110	(1.690, 9.995)	**0.002**
Second Trimester	5.689	(2.286, 14.158)	< **0.001**
First Trimester	Reference		
Previously Had PIH			
Yes	20.409	(8.938, 46.600)	< **0.001**
No	Reference		
Family History of HBP			
Yes	1.119	(0.703, 1.782)	0.635
No	Reference		
History of Chronic Condition			
Yes	7.301	(3.530, 15.101)	< **0.001**
No	Reference		
Medical Supervision			
Yes	1.901	(1.100, 3.286)	**0.021**
No	Reference		
Rice Intake			
3-4 Times Per Day	0.866	(0.542, 1.386)	0.549
1-2 Times Per Day	Reference		

Wheat Flour Intake			
3-4 Times Per Day	0.405	(0.040, 4.110)	0.444
1-2 Times Per Day	0.311	(0.032, 3.030)	0.314
Don’t Take	Reference		
Fruits Intake			
Don’t Take	1.102	(0.695, 1.745)	1.000
1-2 Times Per Day	0.908	(0.290, 2.837)	0.680
3-4 Times Per Day	Reference		
Vegetables Intake			
Don’t Take	0.438	(0.069, 2.762)	0.379
1-2 Times Per Day	0.500	(0.090, 2.778)	0.428
3-4 Times Per Day	Reference		
Processed Foods Intake			
3-4 Times Per Day	1.464	(0.337, 6.365)	0.611
1-2 Times Per Day	0.755	(0.473, 1.203)	0.237
Don’t Take	Reference		
Red Meat Intake			
1-2 Times Per Day	1.147	(0.725, 1.815)	0.558
Don’t Take	Reference		
Fish Intake			
3-4 Times Per Day	1.574	(0.274, 9.045)	0.611

1-2 Times Per Day	0.565	(0.293, 1.091)	0.089
Don't Take	Reference		
Chicken Intake			
3-4 Times Per Day	0.934	(0.587, 1.487)	1.000
1-2 Times Per Day	0.242	(0.049, 1.186)	0.774
Don't Take	Reference		
Eggs Intake			
1-2 Times Per Day	0.918	(0.574, 1.467)	0.719
Don't Take	Reference		
Supplements Intake			
Yes	2.043	(0.501, 8.329)	0.319
No	Reference		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

The univariate logistic regression analysis in table 4.6 was performed to assess the association between various factors like demographic, socioeconomic, health-related factors, and dietary choices and the risk of PIH. The analysis results are presented as crude odds (cOR) ratio with 95% confidence intervals (CI) and p-values. It is also showing numerous statistically significant factors associated with PIH among pregnant women in Upper River Region, with p-values of <0.05. Women monthly household income of D1,000 < D5,000 had an odds ratio (OR) of

4.286 (95% CI: 1.535, 11.968, p=0.005), D5,000 < D10,000 had an odds ratio of 3.911 (95% CI: 1.580, 9.680, p=0.003), and D10,000 < D15,000 had an odds ratio of 3.699 (95% CI: 1.430, 9.571, p=0.007), indicating that women in lower income are 3.7 to 4.3 times more likely to develop PIH compare to those earning ≥ D15,000. There is a strong relationship between household monthly income and risk of PIH, which could be due to limited access to healthcare, poor nutrition, or other socio-economic factors.

Gestational age was a significant predictor, with pregnant women in their second trimester had an odds ratio of 5.689 (95% CI: 2.286, 14.158, p<0.001) and those in their third trimester had an odds ratio of 4.110 (95% CI: 1.690, 9.995, p=0.002) exhibiting a markedly higher risk of PIH compared to those in the first trimester. This reveals that the risk of PIH increases significantly as the pregnancy progress, with the second trimester showing the highest risk at 5.7 times more likely to develop PIH compared to those in the first trimester. Women with a history of previously having PIH were found to be at an increased the risk of PIH, with an odds ratio of 20.409 (95% CI: 8.938, 46.600, p<0.001), signifying they were 20.4 times more likely to develop PIH compared to those without a history of having PIH previously. Suggesting that past experiences with PIH are a critical predictor for future occurrences.

Likewise, a history of a chronic conditions significantly increased the risk of PIH development with an odds ratio of 7.301 (95% CI: 3.530, 15.101 p<0.001), indicating these women with history of chronic conditions were 7.3 times more likely to develop PIH compared to without such history. Women under medical supervision also show significant associations with PIH, with an odds ratio of 1.901 (95% CI: 1.100, 3.286, p=0.021), predicting that women undergoing medical supervision are 1.9 times more likely to develop PIH compare to those without supervision. This might show that women with higher-risk pregnancies are more likely to seek medical supervision, rather than supervision itself causing PIH.

On the other hand, variables like age group, educational level, number of pregnancies, family history of hypertension and dietary factors including the intake of rice, wheat flour, fruits, vegetables, processed foods, red meat, fish chicken, eggs, and supplements did not show statistically significant associations with PIH. Suggesting that these may not be primary risk factors in developing PIH among the study population of the region. As age and gravida were used as the matched categories, and for dietary choices both cases and controls almost had the same intake pattern during gestation.

In summary, these findings underscore the position of targeting high-risk groups, such as pregnant women who had PIH history previously, who had history of

chronic health condition, those with lower monthly household income, gestational timing and undergoing medical supervision to reduce the prevalence of PIH. Also stressing the need for holistic public health interventions that prioritize early detection, monitoring and management through regular prenatal care and provide well-tailored support to vulnerable pregnant women in order to address socio-economic disparities. This insight is vital for the development of effective preventive measures and educational campaigns aimed at reducing the incidence of PIH among the study population.

Table 4.7: Multivariate Logistic Regression Analysis of Factors Associated with Pregnancy-Induced Hypertension (PIH) Among Pregnant Women in the Upper River Region, The Gambia.

Variable	Multivariate analysis		
	aOR	**(95% CI)**	**P-Value**
Household Monthly Income			
D1,000 < D5,000	8.401	(2.427, 29.077)	**0.001**
D5,000 < D10,000	6.066	(2.127, 17.3702)	**0.001**
D10,000 < D15,000	5.255	(1.761, 15.685)	**0.003**
≥ D15,000	Reference		
Gestational Age			
Third Trimester	4.773	(1.661, 13.721)	**0.004**
Second Trimester	6.277	(2.130, 18.497)	**0.001**
First Trimester	Reference		
Previously Had PIH			
Yes	27.057	(9.632, 76.004)	**< 0.001**
No	Reference		

NB: *P-values indicate the level of statistical significance. A P-value <0.05 is considered statistically significant.*

In conducting the multivariate logistic regression analysis, I included only those variables that were found to be significant in the univariate logistic regression analysis. As the univariate analysis serves as a preliminary screening step to

identify variables that have a significant association with PIH outcome. This approach was taken to avoid overfitting, which can occur when too many variables are included in the model, especially when some of these variables may not contribute significantly to PIH outcome. To also enhance the model's predictive accuracy and reliability, likewise it will be easier to interpret and understand.

The multivariate logistic regression analysis in table 4.7 adjusts for potential confounding variables, providing a more accurate estimate of the independent effect of each variable on the outcome (PIH). Analysis results are presented as adjusted odds (aOR) ratio with 95% confidence intervals (CI) and p-values. The analysis identified household monthly income, gestational age, and history of PIH previously as significant independent predictors of PIH among pregnant women in the Upper River Region. Pregnant women in lower income brackets were at a significantly higher risk of developing PIH compared to those earning higher income. As those earning D1,000 < D5,000 being 8.4 times more likely to develop PIH (adjusted OR= 8.401, 95% CI: 2.427, 29.077, p=0.001), those earning D5,000 < D10,000 being 6.1 times more likely to develop PIH (adjusted OR= 6.066, 95% CI: 2.127, 17.3702, p=0.001), and those earning D10,000 < D15,000 being 5.3 times more likely to develop PIH (adjusted OR= 5.255, 95% CI: 1.761, 15.685,

p=0.003) compared to those earning ≥ D15,000. Household monthly income, mainly lower household income remains a strong independent risk factor associated with an increased risk of PIH, even after adjusting for other factors. This suggests that socio-economic disparities significantly contribute to the risk of PIH.

Additionally, the risk of PIH increased significantly with advancing gestational age. Women in their third trimester were 4.8 times more likely to develop PIH (adjusted OR= 4.773, 95% CI: 1.661, 13.721, p=0.004), and those in their second trimester were 6.3 times more likely to develop PIH (adjusted OR= 6.277, 95% CI: 2.130, 18.497, p=0.001) compared to those in the first trimester. The risk of PIH development increases significantly as pregnancy progresses, with second trimester posing the highest risk. This signified the need for intensified monitoring and management of PIH throughout pregnancy, particularly in the later stages. Furthermore, women with a history of PIH previously were 27.1 times more likely to develop PIH (adjusted OR= 27.057, 95% CI: 9.632, 76.004, p<0.001) compared to those without any history of PIH, making it the strongest independent risk factor of PIH in this study, stressing the need for targeted interventions and close follow-ups for women with prior history of the condition.

These findings stress the importance of addressing socio-economic disparities; by implementing programs targeting access to healthcare, nutrition, and health

education for low-income women. Enhancing prenatal check-ups; particularly for women in the second and third trimester for early detection and management of PIH, and providing specialized care and regular follow-ups for women with history of PIH previously to prevent recurrence, reduce the burden of PIH and improve maternal health outcomes in the Upper River Region.

Chapter V Discussions

This Case-Control study is the first of its kind in the Upper River Region, a matched case-control study and it assessed the prevalence and associated factors of Pregnancy-Induced Hypertension among pregnant women in the Upper River Region of The Gambia. The comprehensive analysis driven from the graphs and tables of data, provides critical understandings into the prevalence, demographic, socio-economic, health and pregnancy history, and nutritional and lifestyles influence on PIH outcomes among the 292 study participants. It also resonates and aligns with numerous key findings from both local and international studies. The independent t-test done in this study compared continuous variables, while the chi-square tests compared categorical variables between cases and controls. The logistic regression (univariate and multivariate) tests address the association between specific risk factors and PIH, which were central to our research objectives.

5.1 Summary of Key Findings

The prevalence of PIH in the region was found to be higher compared to the other six regions, with a slight decline from 4.55 in 2020 to 4.04% in 2024. Notwithstanding, Upper River Region consistently recorded the highest prevalence

among the seven health regions, highlighting the need for targeted intervention. Significant risk factors identified included lower household monthly income, advanced gestational age, a history of PIH in previous pregnancies, and history of chronic health condition. Socio-economic factors, such as income level, were strongly associated with PIH, while nutritional and lifestyle behaviors showed no significant association.

5.2 Prevalence of PIH

The prevalence of PIH in URR was higher (4.04%) compare to the other six health regions, with fluctuating trend over the past six years. This finding aligns with studies in lower-resource settings, where PIH prevalence is often in huge numbers due to limited resources, hindering the access to healthcare, access to nutritious food and education (56,76). The slight decline in the number of cases from 2022 to 2024 may reflect better antenatal care and health interventions in the region, but persistently high rates highlight the need for sustained efforts that can improve the maternal health outcomes in the region. A noteworthy finding was also observed in the chi-square analysis, where the highest prevalence of cases 43.2% were the 25-34 years age group and 29.5% were the 15-24 years age group.

5.3 Sociodemographic Factors

Lower household monthly income was a significant predictor of PIH in both the univariate and multivariate analyses performed in this study. Women in the lowest income bracket (D1,000<D5,000) were 8.4 times more likely to develop PIH (aOR= 8.401, 95% CI: 2.427, 29.077, p=0.001), compared to reference group, those in the highest income bracket (≥ D15,000). Pregnant women from lower-income households are likely to face greater challenges in accessing quality healthcare and to get a well-balanced diet during the course of gestation, which can lead to being at risk of PIH, delayed diagnoses, inadequate management of PIH and lack of good nourishment for both mother and child. This finding is consistent with studies pointing out the link between poverty and adverse maternal outcomes (77,78). Limited financial earnings can jeopardize the accessibility and affordability of quality healthcare and healthier food intake, increasing the risk of PIH development. This cemented the notion that individuals in the lower-income group are at a higher risk of developing PIH. These findings align with literatures that highlight the impact of socio-economic status on maternal health outcomes. For instance, a study stressed that lower income can lead to adverse pregnancy outcomes (61). Similarly, a study in Sweden found that pregnant women from lower-income backgrounds often have limited access to prenatal care, which is a

key component in monitoring and managing blood pressure during gestation. This lack of access, thus increases their risk for PIH (59). Additionally, a study by Kim, M.K., et al. (2018) revealed that dietary factors related to income levels can significantly affect pregnancy outcomes. Women from lower socio-economic backgrounds often have poorer dietary consumption, less likely to receive adequate prenatal care which in turn contribute to hypertensive disorder development during gestation and the risk of adverse pregnancy outcome (79). More than half of the cases household monthly income was less than D10, 000, underscoring the influence of economic stability on maternal health. This aligns with a study in The Gambia, that associated the burden of NCDs including hypertension, with rapid urbanization and changing dietary patterns, which may disproportionately affect lower income populations, and consistent with another study in sub-Saharan Africa that link socio-economic status to adverse maternal health outcomes (45,80). For example, a study in Harare; Zimbabwe highlighted pregnant women from lower socio-economic status are prone to increased risks of complications related to PIH, emphasizing the need for targeted interventions to address economic disparities and improve maternal health outcomes (45). Therefore, a study conducted in India encouraged policymakers to implement strategies that address disparities, such as

education and healthcare services accessibility for low-income population, to reduce the incidence of PIH and improve maternal health outcomes (35).

However, this study shows that there is no significant difference in age between cases and control, with mean age of 29.56 and 29.97 years respectively (p=0.805), suggesting age may not be a strong determinant or a strong risk factor for PIH in this study population. Notwithstanding, the categorization of age on a Chi- square test revealed a higher prevalence of PIH in the age group of 25-34, suggesting age may still play a role in risk profiles and aligning with results from other studies that indicates advance maternal age is a known risk factor for hypertension disorder during gestation. For instance, research conducted in The Gambia has shown that advanced maternal age correlates with increased risk of complication such as pre-eclampsia and gestational hypertension (14). Likewise, another study conducted in Ethiopia, identified age at first conception as a predictor of PIH, suggesting that older maternal age may upsurge the risk of hypertensive disorders during pregnancy (13). And longitudinal studies also have established that prevalence of hypertension upsurges with age in individuals with family history of hypertension (48).

Fascinatingly, marital status, educational attainment, occupation, ethnicity and gravida did not show significant differences, suggesting that these

sociodemographic factors may not be as impactful in this context of our PIH study. Likewise, height of study participants and their family history of hypertension did not also show any significant differences among cases and controls. Moreover, two studies spotted out these sociodemographic variables as association with PIH, but also found out weight and pre-existing medical condition were less significant when compared to risks of PIH (13,47). A study in Sweden shows women with lower educational attainment were found to have an increased risk of preeclampsia, with an adjusted risk ratio of 1.16 for those with low education compared to those with the highest educational qualifications. This highlights the importance of education in understanding and managing health risks during pregnancy (59). These studies were not seen to translate with our study, highlighting other modifiable factors may play a more role in the development of PIH, warranting a focused approach in prevention strategies.

5.4 Health and Pregnancy History

A history of PIH in previous pregnancy was the strongest predictor of recurrence, with women who previously had PIH being 27 times more likely to develop the condition again (OR=27.057, $p<0.001$). This result is consistent with global studies indicating that a history of hypertensive disorders meaningfully increases the risk of PIH recurrence (81). The study shows that a significant proportion of

cases (50.7%) reported of experiencing PIH in their previous pregnancies compared to small fraction (4.8%) of controls, P- value <0.001. Case group also had a higher mean with the number of PIH diagnoses ($\bar{x}$=2.36) compared to the control group ($\bar{x}$=1.43), p=0.011, reinforcing the importance of a history of PIH as a risk factor. Signifying women with PIH history previously; are at a higher risk of experiencing PIH in subsequent pregnancies, which resonate with the results from across-sectional study in Mettu Karl Referral Hospital, Ethiopia that found history of PIH or pre-eclampsia significantly increased the risk the developing the condition in subsequent pregnancies (47). Another study conducted in The Gambia by Cham, B., et al. (2018) found a similar trend, indicating that women with prior history of pregnancy hypertensive disorder are more likely to experience maternal health complication than the normotensives (14). This study's solid association highlights the need of monitoring pregnant women with a prior history of PIH. This finding is in line with a systematic review that indicates women with prior history of PIH are more prone to experience adverse pregnancy outcomes, including severe hypertension and pre-eclampsia in subsequent pregnancies (52).

The risk of PIH increased significantly with advancing gestational age, particularly in the second trimester (OR=6.277, P<0.001). Cases also had a significantly lower mean gestational age ($\bar{x}$=23.24 weeks) compared to controls ($\bar{x}$=24.67 weeks) p=

0.001. This aligns with evidence that hypertensive disorder often manifest after the 20^{th} week of gestation, which is mid-to-late pregnancy due to physiological and increased placental demand (82). This finding corresponds with a study in Rwanda that stresses that women in the second trimester show a higher incidence of PIH, suggesting that the physiological changes that arise during this period may predispose them to PIH (83). Early detection and monitoring during this period are critical in reducing maternal complications. Likewise, pregnant women with chronic health conditions were 7.3 times more likely to develop PIH (OR=7.301, $p<0.001$), emphasizing the need for integrated care for pregnant women with comorbidities (84). Additionally, the study found a significant correlation between participants' history of chronic health conditions and the risk of developing PIH, showing that 34.9% of all cases had chronic health issues compared to only 6.8% of controls; indicating that pre-existing health issues are a major risk factor for developing PIH. Highlighting the need for careful management of pre-existing chronic health issues during gestation and researchers pointed out that non-communicable diseases (NCDs) like diabetes mellitus and renal diseases significantly increase the risk of PIH (52,85). Others studies also indicated that women with pre-existing chronic conditions are more likely to face maternal complications during pregnancy, including PIH complications (30,67). A

higher proportion 30.1% of cases reported receiving medical supervision compared to only 18.5% of controls, which may reflect the need for medical intervention among high-risk pregnant women. This study also found that pregnant women who received medical supervision had 1.9 times higher odds (OR=1.901, P=0.021) of developing PIH compared to those who did not. This finding may reflect better detection of PIH in women under medical supervision or the presence of underlying risk factors in this group. In other words, medical supervision may not cause PIH but could lead to better detection of the condition. Thus, the higher odds of PIH in this group may reflect the underlying risk factors for PIH (example PIH history previously and history of chronic health conditions) rather than the medical supervision itself. This finding is consistent with studies suggesting that regular antenatal care increases the detection of hypertensive disorders (76,86). Expectant mothers' regular check-ups are crucial in preventing conditions like PIH. The result align with existing study that underscores the need of prenatal care in identifying and managing potential health risks during pregnancy (35). However, this contrasts with evidence from World Health Organization (2016) and Magee, L. A., et al. (2014), which highlight that effective medical supervision like quality antenatal care, blood pressure monitoring and lifestyle counseling to be protective against and can reduce the risk of PIH, as it enables early intervention and management

(78,87). This discrepancy may be due to difference in the quality of medical supervision, particularly in low-resource settings where access to effective interventions is limited (88). Effective interventions reducing PIH and its associated risk in some settings, while detective bias or inadequate management may explain the increased risk in others. Further research is needed to explore the causal mechanism underlying this association and improve the quality of antenatal care in low-resource settings like The Gambia.

Other findings for the health and pregnancy history under the independent t-test were the higher mean on participants' pre-pregnancy weight mean of 64.38kg for cases compared to the 60.49kg mean weight for the controls, with a $p<0.001$ and that of the weight during gestation with a mean weight of 69.21kg for the cases compared to 64.8kg mean weight for the control at a $p<0.001$. These results suggest that PIH development in pregnancy is associated with higher pre-pregnancy weight and current weight. Consistent with studies linking obesity to hypertensive disorders (82,84). These findings also align with other studies conducted by Lewandowski, M. et al. (2020) and that of Fikadu, K. et al. (2020). Results from these two studies reveled pregnant women with pre-pregnancy obesity and an increased weight gain during pregnancy have shown to compound the risk of PIH recurrence in subsequent pregnancies, PIH development and also being linked to a

higher incidence of PIH (67,89). These findings emphasize the significant of weight management as a key strategy in the prevention of PIH. This is supported by studies, that specify that both pre-pregnancy and gestational weight gain are key factors inducing the likelihood of developing PIH (23,39,90). Pre-pregnancy weight and the weight of pregnant women are modifiable risk factors for PIH, pregnant women with higher body mass index (BMI) are at increased risk for PIH, and proper weight management both before and during pregnancy can meaningfully help in reducing this risk.

Furthermore, antenatal care attendance is not a barrier for both cases and controls. Predominantly 98.6% of cases and 100% of controls attend prenatal check-up on monthly basis, with no differences p=0.365 between those with the condition of PIH and those without. This finding is consistent with the study from Ethiopia at Mettu Karl Referral Hospitals, which pointed out the benefits of regular ANC visit in the swift diagnosis and management of pre-eclampsia, ultimately reducing maternal and perinatal morbidity (47). Other studies also highlight the critical role antenatal care plays in identifying hypertensive disorders, but its effectiveness in reducing maternal and newborns complications depends on the availability of resources and trained healthcare providers (86,91).

5.5 Nutritional and Lifestyle Factors

Contrary to expectations, nutritional and lifestyle factors showed no significant association with PIH. This contrasts with studies in other settings where poor nutrition, and sedentary lifestyles were linked to hypertensive disorders (43,78). The lack of association on dietary patterns in our study may reflect the homogeneity of dietary choices among the cases and controls or the limitations of self-reported data. Lifestyle factors, including smoking and alcohol consumption show no significant differences between cases and controls group, with both participants reporting zero usage. Suggesting a positive health-conscious demographic in this study and consistency with other studies that concluded that smoking and alcohol consumption rate were notably low among women in The Gambia (80). Other lifestyle choices, such as physical activity levels and sleeping hours and did not significantly differ between cases and controls group, indicating these lifestyle choices may not be major contributors to the development of PIH in the Upper River Region. This observation is consistent with previous studies that indicated that lifestyle choices play a role in general health, their direct effect on PIH to be less significant when compare to pre-existing health issues and weight control (18,25).

In summary, this study's findings provide valuable insights into the prevalence and risk factors of PIH in URR of The Gambia and underscore the importance of addressing socio-economic disparities, and provision of targeted health care for high-risk pregnant women to mitigate the burden of PIH and improve maternal health outcomes. These findings are consistent with global evidence on the socio-economic and medical determinants of PIH. For instance, the strong association between lower income and PIH reflects findings from studies in sub-Saharan Africa (34,49,77). Similarly, the high recurrence risk among pregnant women with history of PIH aligns with evidence from high-income countries (38,79,81). However, the lack of association between lifestyle factors and PIH contracts with studies in urban settings, suggesting the contextual factors, such as rural living and limited dietary diversity, may play a role (15,34,66).

5.6 Strengths and Limitations of Study

This study has strengths that enhance its validity and contribution to the field of maternal health research. The use of a 1:1 case-control design permits for a robust comparison between cases and control, making it predominantly effective for studying risk factors. The collection of both primary and secondary data ensures that the findings unique and tailored to the context of this study, while the comprehensive statistical analysis adds rigor and reliability to the results.

Moreover, the focus on a low-resource settings, The Gambia offers context-specific insights that are often underrepresented in the global literature. The findings from this study have significant public health implications, offering realistic recommendations for interventions to reduce the PIH burden. Overall, this study contributes valuable evidence to the literature and lays the groundwork for future research and policy initiatives aimed at improving maternal health outcomes.

Limitations on this study include the reliance on secondary data from the DHIS-HMIS of the ministry of health to determine the prevalence of PIH, which was a hurdle as the data from this data bank only contains absolute figures reported by health facilities, which are segregated in district and regional variation lacking key information like demographic information of cases. This limited us to conduct in-depth analyses of the trend of cases observed in health regions and districts of URR over the years analyzed. Likewise, self-reported data, which could introduce recall bias and the inability to account for potential cofounders, such as environmental factors and genetic predispositions. The findings in this study may also not be generalized for the country as the study was completely conducted in URR, which is a single health region of the country and have different characteristics compared to the other six health regions. Future studies

should adopt longitudinal designs and include biomarkers to address these limitations.

Chapter VI Conclusion and Recommendation

6.1 Conclusion

This thesis investigated the prevalence and associated factors of Pregnancy -Induced Hypertension in the Upper River Region of The Gambia. Though rigorous data collection and a comprehensive statistical analysis, the findings established that the prevalence of PIH within this region to be a significant burden, and identified lower household monthly income, advanced gestational age, a history of PIH in previous pregnancies, history of chronic health condition and medical supervision as significant risk factors to PIH. The prevalence of PIH in the region was found to be 4.04% in 2024, indicating a significant public health concern. The firm increase of prevalence of PIH yearly in the region suggests a pressing need for enhanced maternal health services and underscores the need for targeted educational programs aimed at pregnant women and healthcare providers. Such interventions should focus on risk factors awareness, the importance of regular prenatal visits, and lifestyle modifications that could mitigate the risk associated with PIH in this population.

Socio-economic factors, such as lower household monthly income showed a strong association with an increased risk of PIH. Pregnant women in the lowest income

bracket had significantly higher odds (aOR=8.401, 95% CI: 2.427, 29.077, p=0.001) of developing PIH compared to those in higher income group. Highlighting the role of socio-economic disparities had on maternal health outcomes and call for polices that focuses at improving economic conditions and access to health services for vulnerable population. Specifically, income support programs, enhanced antenatal care, and integrated care for high-risk women essential. Likewise, pregnant women with history of PIH in their previous pregnancy stand out as the strongest predicting independent risk factor to PIH development with increased odds (aOR=27.057, 95% CI: 9.632, 76.004, p<0.001) and advance gestational age was also found to increase the risk of developing PIH significantly, pregnant women the second trimester having higher odds (aOR=6.277, 95% CI: 2.130, 18.497, p=0.001). Heightened surveillance, preventive strategies, and comprehensive antenatal care for these groups can reduce the risk of PIH, reinforcing the critical role health management plays in preventing PIH.

In summary this study highlights the need for health interventions, including improved access to antenatal services and education on risk factors to PIH. The findings underscore the importance of addressing these broader determinants and call for an inclusive maternal health programs that address the risk of PIH and

provide targeted care for high-risk women. Improving access to quality healthcare, implementing community-based programs on PIH risk factors, and advocating for policies that address socio-economic inequalities. Strengthening healthcare system to ensure early detection and management of PIH is critical in reducing PIH prevalence, and providing financial support for parental care could significantly not only reduce the prevalence of PIH but also improve overall maternal health and fetal outcomes in the region. Ultimately, collaboration among healthcare providers, policymakers, and community leaders is crucial in addressing these unique health challenges the region is faced with. Finally, future longitudinal studies are needed to explore causal relationships and evaluate the effectiveness of interventions in reducing PIH prevalence. By addressing these pressing issues, policymakers and healthcare providers can work towards improving maternal health and reducing the burden of PIH in The Gambia and similar settings.

6.2 Recommendations

Based on the study's findings of Upper River Region's disproportionately high PIH prevalence (4.04%) and key risk factors, a multipronged approach is critical to addressing PIH in the region. Firstly**,** DHIS2 should be fully leveraged to establish real-time PIH surveillance in the region, enabling targeted resource allocation to high-burden districts and continuous monitoring of ANC quality indicators,

including mandatory blood pressure monitoring at every visit and standardized protocols for managing high-risk pregnancies, particularly for women with a history of PIH history (aOR=27.057) or chronic conditions (cOR=7.301). Secondly**,** given the critical second-trimester risk window (aOR=6.277), ANC protocols must be strengthened to include mandatory bi-weekly blood pressure monitoring and urine protein checks between weeks 13-24, complemented by community-based early warning systems using trained Village Health Workers (VHWs) and Community Birth Companions (CBCs). Thirdly, to address the region's socioeconomic disparities, shown by 8.4 times higher PIH odds in low-income groups. Targeted interventions should include ANC access to this category of people and remote areas (increase mobile RMNCAH clinics), nutritional support programs to mitigate modifiable risks, and task-shifting strategies to deploy more midwives to underserved areas. Community education campaigns should raise awareness of PIH symptoms and the importance of early ANC enrollment, using local networks like Village Support Groups (VSGs) to reach vulnerable populations and key decision markers in families. Finally**,** these efforts should be institutionalized through national policy reforms that establish URR-specific PIH reduction targets, with progress tracked through DHIS2's longitudinal data capabilities. Together, these recommendations

create a comprehensive framework that addresses both the clinical and socioeconomic dimensions of PIH in URR while leveraging existing health information systems for sustainable impact. Future implementation research should evaluate the cost-effectiveness of these interventions and their potential for replication in similar settings across The Gambia.

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Appendix

List of Abbreviations

DHIS2: District Health Information System 2

HMIS: Health Management Information System

LMICs: Low and Middle Income Countries

MoH: Ministry of Health, The Gambi

NCDs: Non-Communicable Diseases

PIH: Pregnancy Induced-Hypertension

RHD: Regional Health Directorate

RMNCAH: Reproductive, Maternal, Neonatal Child and Adolescent Health

URR: Upper River Region

WHO: World Health Organisation

School Support Document

南方医科大学援外公共卫生硕士项目来华留学硕士研究生导师接收函

SMU IMPH Tutor's Acceptance Letter

本人经过了解考察，认为该学生有较好的学习潜力，愿意接收其为本人 2023 年度硕士研究生。

After investigation, I think that the applicant mentioned below has enough potential to pursue his/her study at Southern Medical University. Hereby I agree to accept him/her as my 2023 Master student.

申请学生信息/STUDENT INFORMATION:

护照姓名 PASSPORT NAME	CHERNOR H. JALLOW
护照号码 PASSPORT	PC 211652
国　　籍 NATIONALITY	GAMBIAN
研究方向 RESEARCH DIRECTION	PREGNANCY INDUCED HYPERTENSION

导师签名/Supervisor Signature: 张吉年

联系电话/Cell Phone: 15800018326

邮箱地址/Email Address: 22qaabol@smu.edu.cn

所在单位/School: 公卫学院

备注：提交本函表明导学关系已确立，学生原则上不得转导师。

Note: The submission of this letter indicates that the tutor has confirmed to accept the student, and it's not allowed to change the tutor in principle.

南方医科大学国际教育学院外国留学生请假条

Leave Application Form for International Students In School of International Education of SMU

姓名(Name): CHERNOR H. JALLOW 学号(Roll No.): 2023YM10

护照号码(Passport No.): PC 211652 房间号码(Room No.): 727

境内联系电话(Contact No. in China): 13148996061

境外联系电话(Contact No. out of China): (00220) 9809363/3922075

请假时间(Leaving Period): From 13-07-24 (date) 至 to 05-10-24 (date),

共____ 天(days in total) _____节课 (class hours in total, 1 class hour = 40 mins)

请假事由(Reason for absence): Primary Data collection for my Thesis and application for ethical approval from The Gambia Ethics Committee.

安全责任人(Guarantor of the Safety Responsibility): My Self

请假人签名(Sign): [signature] 日期(Date): 5/7/24

批准人及日期(Approver & Date): [signature] 2024.7.8

以下由国际教育学院辅导员保存 (The following copy is kept by the Supervisor):

南方医科大学国际教育学院外国留学生请假条

姓名(Name): CHERNOR H. JALLOW 学号(Roll No.): 2023YM10

护照号码(Passport No.): PC 211652 房间号码(Room No.): 727

境内联系电话(Contact No. in China): 13148996061

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请假事由(Reason for absence): Primary Data collection for my Thesis and application for ethical approval from ethics Committee

安全责任人(Guarantor of the Safety Responsibility): My Self

请假人签名(Sign): [signature] 日期(Date): 5/7/24

批准人及日期(Approver & Date): [signature] 2024.7.8

南方医科大学国际教育学院
SCHOOL OF INTERNATIONAL EDUCATION OF SOUTHERN MEDICAL UNIVERSITY
网址 Website: https://istudy.smu.edu.cn/ 电话 Tel: 0086-20-61648354

RECOMMENDATION LETTER FOR DATA

COLLECTION AND RESEARCH WORK

To Whom it may concern,

This is to certify that Chernor H. Jallow is a bona fide student of the Master of Public Health (MPH), from Southern Medical University, Guangzhou, China. He is conducting research entitled "Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region, The Gambia" under the supervision of Professor Zhang Zheqing. He needs to collect secondary data from the following institutes under your management: Health Management Information System of Ministry of Health; The Gambia, Gambia Bureau of Statistics, Demography of Health Survey of The Gambia and primary data from a sample of pregnant women in the 7 districts in Upper River Region of the country. If you have any queries or concerns regarding this project, please direct them to Professor Zhang Zheqing by email: zzqaa501@smu.edu.cn.

Any assistance accorded to him is highly appreciated. Thank you for your attention and assistance. Your approval will be highly appreciated.

School of International Education

Southern Medical University

July 5th, 2024

南方医科大学公共卫生学院
School of Public Health Southern Medical University
中国广州 510515 电话：61648324 传真：61648324 邮箱：gwxy@fimmu.com

RECOMMENDATION LETTER FOR DATA

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School of International Education

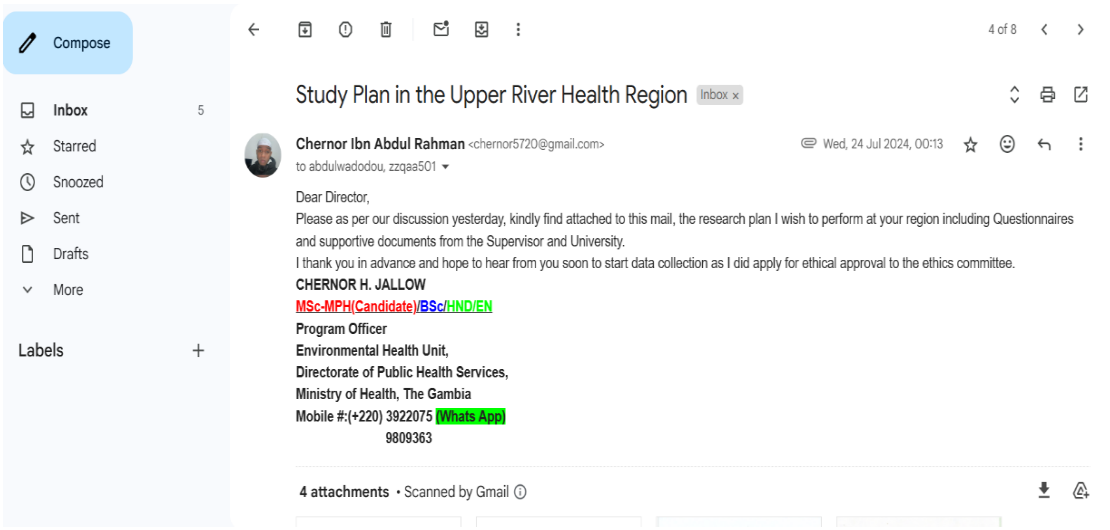
Southern Medical University

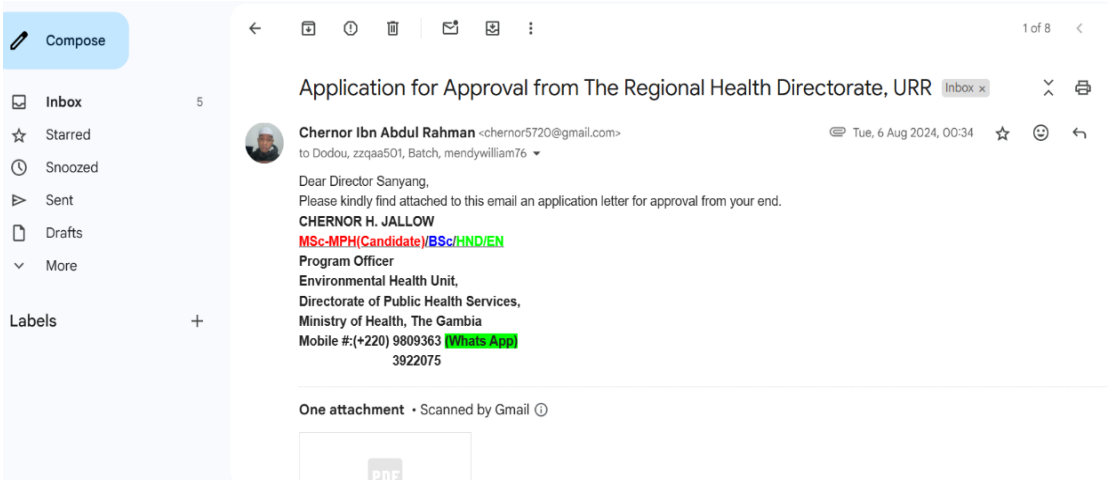
July 5th, 2024

Zheqing Zhang

7/8/2024

Correspondence for Ethical Approval





Chernor H. Jallow,
Southern Medical University (SMU),
Student Apartment No. 2; Room 727,
Baiyun District; Guangzhou City,
Guangdong Province; China,
(+86) 13148996061/(+220)3922075/9809363
05th August, 2024.

Regional Director of Health Services,
Regional Health Directorate,
Upper River Region,
Basse Mansajang Kunda,
The Gambia

Application for Approval of Data Collection for Research Study

Dear Director,

I hope this letter finds you and team well. I am writing to seek your approval to conduct a research study titled "**The Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region, Mixed-Methods Study Combining Secondary Data and Primary Questionnaire Surveys.**"

Purpose of the Study: The primary objective of this study is to determine the prevalence of PIH in the Upper River Region, and the secondary objective is to identify factors associated with PIH. This research is crucial for understanding the regional disparities within The Gambia and for informing targeted interventions and policies that will improve maternal health outcomes.

Data Collection Method: The study will employ a mixed-methods approach, combining secondary data analysis with primary data collection through structured and semi-structured questionnaires. The questionnaires will be administered to women of childbearing age in the region, using a stratified sampling method.

Ethical Considerations: I am committed to conducting this research ethically, with respect for the privacy, confidentiality, and well-being of all study participants. Ethical approval is sorted from the relevant ethics committee of the country and I will ensure that all participants provide informed consent.

Significance of Approval: Your approval is essential for me to proceed with the data collection phase of the study. The insights gained from this research will contribute significantly to the body of knowledge on PIH and will be instrumental in guiding healthcare policies and practices in The Gambia, particularly in the Upper River Region.

Next Steps: Upon receiving your approval, I and data collectors will initiate the data collection process, ensuring that all activities are conducted in accordance with the guidelines provided by your Directorate and the ethical standards of our institution.

I kindly request your prompt consideration of this application. I am available to provide further information or clarification as needed and would be happy to discuss the study in more detail at your convenience.

Thank you for your attention to this important matter. I look forward to your positive response and the opportunity to contribute to the health and well-being of the communities in the Upper River Region.

Sincerely,
Chernor H. Jallow
Program Officer/International Student-SMU

REPUBLIC OF THE GAMBIA
MINISTRY OF HEALTH
REGIONAL HEALTH DIRECTORATE, UPPER RIVER REGION, BASSE

Mob: +220 3951091
Email: mohrhdurr@gmail.com

Ref: RHD/47/2024

07th August 2024

Chernor H. Jallow,
Southern Medical University (SMU),
Baiyun District; Guangzhou City,
Guangdong Province; China

Dear Sir,

APPROVAL TO CONDUCT A RESEARCH STUDY

The office has approved your request to conduct a research study titled *"The Prevalence and Associated Factors of Pregnancy Induced Hypertension (PIH) in the Upper River Region, A Case- Control Study Combining Secondary Data and Primary Questionnaire Surveys."*

We request that you conduct this research ethically, with respect for the privacy, confidentiality, and well-being of all study participants. With this letter, all our relevant health facilities are permitted to make records and space available for your smooth data collection.

Wish you a successful data collection exercise and a successful study.

Kind Regards.

Dodou Sanyang
Regional Director of Health Services
Regional Health Directorate – URR
Basse – Upper River Region
Email: abdulwadodou@gmail.com

cc: OICs Health Facilities
DHS
File

REGIONAL HEALTH DIRECTORATE
DATE: 07/08/24
SIGN:
BASSE URR.

Participants' Consent Letter

Tittle: *The Prevalence and Associated Factors of Pregnancy Induced-Hypertension (PIH) in Upper River Region (URR), The Gambia*

Dear Madam,

I am a student pursuing Master in Public Health at Southern Medical University, Guangzhou, China. I am interested in the above caption for my thesis in partial fulfilment of my degree program. The main objective of this study is to determine the prevalence of pregnancy induced hypertension (PIH) and the associated factors among antenatal in the region.

There are no direct/immediate benefits but I hope this research will provides valuable information on the prevalence and associated factors of PIH; which will guide policy makers. It will also guide the formulation of health education strategies on PIH and help medical personnel with strategies on reducing maternal morbidity and mortality.

There will be no collection of blood, urine or stool sample and participants will only be answering questions and is purely voluntary. One can withdraw at any stage of the research with no consequences.

The information collected from this study will be anonymous and remains confidential and is for academic purpose only.

You are free to ask any question or clarification needed; you can contact me, Chernor H. Jallow on these numbers 9809363/3922075 or Email: chernor5720@gmail.com OR chernorjallow@gmail.com .

Thanks, and counting on your support and cooperation.

By signing/putting your thumbprint below, you confirm that you have read the information sheet or have had it explained to you in a manner you understand. Your participation in this study is voluntary, and you will not receive any financial compensation. Please indicate your consent by signing below

Study Participant's Signature: ……..…….. Date: ……

Researcher's/Assistant's Signature: …….. Date: ……..

Consent and Contact Information

Do you consent to participate in this study?

- Yes
- No

May we contact you for follow-up interviews or additional information?

- Yes (please provide contact information/WhatsApp):
- No

Case **Control**

Questionnaire

Section 1: Socio-demographic Information

1. Age in years: _____

2. What is your marital Status?
    - Single
    - Married
    - Divorced
    - Widowed

3. What is your educational level?
    - Non-Formal Education
    - Lower Education
    - Higher Education

4. What is your occupation?
    - House wife
    - Working Woman

5. Which ethnic group do you belong to?
    - Fula
    - Mandinka
    - Sarahuleh

- Wollof
- Others: _____

6. What is your religion?
   - Islam
   - Christianity
   - Others: _____

7. What is your monthly household income on estimate?
   - D1,000 < D5,000
   - D5,000 < D10,000
   - D10,000 < D15,000
   - D15,000 and Above

8. Number of Pregnancies (including this one): _____

Section 2: Health and Pregnancy History

9. Gestational age of pregnancy (in weeks) _____

10. What is your weight before current Pregnancy (in Kg)? _____

11. What is your current weight (in Kg)? _____

12. What is your height (in cm)? _____

13. Have you previously had a pregnancy complicated by hypertension?

- Yes
- No

14. If yes, how many times? _____

15. Any family history of hypertension?

- Yes
- No

16. Have you been diagnosed with any chronic health conditions?

- Yes (please specify): _____
- No

17. Are you currently under medical supervision for any health condition?

- Yes (please specify): _____
- No

Section 3: Current Pregnancy Information

18. Have you experienced any of the following symptoms during this pregnancy? (Check all that apply)

- Headaches
- Vision changes
- Upper abdominal pain

- Rapid weight gain
- Shortness of breath
- Other (please specify): _____

19. How often do you attend prenatal check-ups during this pregnancy?

- Weekly
- Bi-weekly
- Monthly
- Less frequently (please specify): _____

20. Have you been diagnosed with PIH during this pregnancy?

- Yes **(Case)**
- No **(Control)**

21. If yes, at what stage of pregnancy was PIH diagnosed?

- 1st Trimester
- 2nd Trimester
- 3rd Trimester

22. Classification of Hypertension:

- **Chronic Hypertension** (Develops before pregnancy or during the first 20 weeks of pregnancy)

- **Gestational Hypertension** (Hypertension among normotensive antenatal without pre-eclampsia signs)
- **Pre-Eclampsia** (Systolic of ≥160 mmHg, or Diastolic of ≥110 mmHg and with Proteinuria)
- **Eclampsia** (Convulsions during pregnancy or postpartum, unrelated to other cerebral pathological conditions)

Section 4: Lifestyle, Nutritional and Environmental Factors

23. Do you smoke?

- Yes
- No

24. If yes, how many cigarettes per day on average? _____

25. Do you consume alcohol?

- Yes
- No

26. If yes, how often? (Please specify): _____

27. Do you engage in regular physical activity?

- Yes
- No

28. How many hours do you engage in physical activity? _____Hours

29. How many hours do you sleep daily _____Hours

30. How often do you sit in a day?

- Rarely
- Occasionally
- Frequently

31. How often do you consume Rice?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

32. How often do you consume Wheat Flour?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

33. How often do you consume Fruits?

- Don’t Take
- 1 – 2 Times Per Day

- 3 – 4 Times Per Day

34. How often do you consume Vegetables?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day
- 35. How often do you consume Processed food/high-salt food (Can Beef, Sardine, etc.)?
- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

36. How often do you consume Red Meat?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

37. How often do you consume Fish?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

38. How often do you consume Chicken?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

39. How often do you consume Eggs?

- Don’t Take
- 1 – 2 Times Per Day
- 3 – 4 Times Per Day

40. Do you take any dietary supplements, such as iron, calcium, or prenatal vitamins, during your pregnancy?

- Yes
- No

Achievements

I am honored to have successfully completed all coursework for my Master of Public Health (MPH) at Southern Medical University (SMU), Guangzhou with distinction, achieving a cumulative GPA of 3.5/4.0 and successfully pioneered an epidemiological study on the Prevalence and Associated Factors of Pregnancy-Induced Hypertension (PIH) in the Upper River Region (URR), The Gambia. A study uncovering critical prevalence rates and risk factors that can reshape maternal healthcare strategies, contributing valuable insights into maternal health epidemiology in low-resource settings, with findings poised to inform targeted interventions for reducing PIH-related morbidity. My thesis, which awaits defense, stands as a testament to my commitment to advancing women's health in underserved communities and underscores my commitment to addressing global health disparities through evidence-based research.

Beyond my academic pursuits, I was privileged to participate in the prestigious inaugural Advanced Course on Comprehensive Strategies to End the Spread of Sexually Transmitted Infections (STIs) (December 1 - 7, 2024), organized by Southern Medical University's Institute of Global Health in collaboration with the World Health Organization (WHO) and the Dermatology Hospital of Southern Medical University. Being selected for the elite WHO- Certified Advanced Course

program armed me with innovative strategies to combat STIs, further solidifying my expertise in preventive health interventions, reflect my dedication to multidisciplinary approaches in public health, equipping me with powerful cutting-edge strategies in STI prevention and control, reinforcing my commitment to evidence-based global health solutions.

My MPH journey marked by rigorous scholarship, field research, and specialized professional development has strengthened my ability to address complex public health challenges through data-driven approaches, poised me to drive meaningful change in global health, turning data into action, challenges into opportunities, and cross-sectoral collaboration for healthier communities.

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