SEROPREVALENCE OF HEPATITIS B AND VACCINE EFFECTIVENESS IN VERTICAL TRANSMISSION PREVENTION AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINICS IN ABYEI, SOUTH SUDAN

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MAY 2025

DECLARATION AND APPROVAL

Student Declaration

I certify that this thesis is my original work, and it has not been used for any award at any institution

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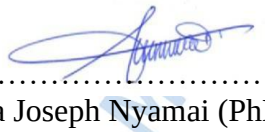

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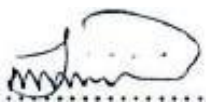

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DEDICATION

I dedicate this PhD thesis to the loving memory of my late mother, Panruel Bol Wol.

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ABSTRACT

The transmission of hepatitis B from mother to child continues to be a significant mode of transmission in many regions around the globe. The absence of timely prenatal screening and the delay in administering vaccinations to newborns are contributing factors to the increased prevalence of Hepatitis B among babies delivered to Hepatitis B- positive mothers. The prevalence of Hepatitis B in South Sudan is 55.5% among babies who are born to women who test positive for HBsAg. The primary objective of this study was to investigate the seroprevalence of hepatitis B and analyze the efficacy of vaccination in preventing mother-to-child transmission. The study focused on a specific set of primary health care facilities, including Abyei Primary Health Care Centre (PHCC) and Ganga Primary Health Care Unit (PHCU). The attendance report for the ANC in Abyei during the last three years documented the participation of 8,135 women. These individuals were evaluated within a hybrid research design that combined elements of both cross-sectional and cohort studies. The process of selecting health facilities for participation was purposeful, considering factors such as distance and the coverage of antenatal care (ANC) services in the area. A representative sample included 384 individuals. The research used a systematic recruitment approach to enroll pregnant mothers who visited ANC clinics. Structured questionnaires were used to gather quantitative data. The collection of qualitative data included conducting Key Informant Interviews and focus group discussions. The collection of quantitative data was facilitated via the use of the Open Data Kit (ODK), while the subsequent analysis was conducted using SPSS version 29.0. Descriptive statistics were used to provide a concise summary of the key features shown by a given dataset. Chi-square analysis was conducted to ascertain the seroprevalence of Hepatitis B across various age cohorts. A multilinear logistic regression analysis was used to assess the risk factors associated with Hepatitis B and their potential correlations with other variables. The theme analysis method was used to examine the qualitative data and to identify and emphasize significant viewpoints, ideas, and quotes expressed by the participants. Results indicated that 19% of the study participants were diagnosed with viral hepatitis B. The results also revealed that all study participants were not aware of the hepatitis B virus. The results also showed that the age of first sexual life ($\chi 2$ =6.1212 (1), p= 0.013), having an incident of STI ($\chi 2$ =154.6550, (df=2), p = 0.000), use of drugs $\chi 2$ =54.7617, (df=1) p= 0.000), and piercing of the nose ($\chi 2$ =18.4305 (df=1) p= 0.000) were significantly associated with hepatitis B seroprevalence. Logistic regression illustrated that having an STI and use of IV drugs were predictors of testing positive for hepatitis B. Among the cohort followed 2 out of 47 of the children born of Hepatitis B positive mothers tested positive for hepatitis B. There was also no significant association between child vaccination and hepatitis B seroprevalence (RR: 0.719 (C.I 0.179-2.893) fisher's exact p = 0.5241). The prevalence of hepatitis B in this study (19%) surpasses the global rates and targeted interventions are required to prevent vertical transmission. There is also a concerning lack of awareness among all participants necessitating comprehensive awareness campaigns in Abyei. The South Sudanese Government should implement practices promoting early and regular antenatal care attendance. Policy efforts should focus on improving testing infrastructure in Abyei South Sudan. Further studies should be conducted to investigate the factors contributing to the relatively higher number of vaccinated children testing positive for HBV.

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LIST OF ABBREVIATIONS & ACRONYMS

ANC	: Antenatal care
BD	: Birth Dose
CDC	: Center for Disease Control and prevention
CHWs	: Community health Workers
COVID-19	: Corona Virus Disease 2019
EDTA	: Ethylene Diamine tetra Acetic Acid
ETV	: Enteavir
HBIG	: Hepatitis B immunoglobulins
HBM	: Health Belief Model
HBsAg	: Hepatitis B Surface Antigen
IVIG	: Intravenous Immunoglobulins
MOH	: Ministry of health
MTCT	: Mother to Child transmission
NGOs	: Non-Governmental Organizations
PHCC	: Primary Health Care Centre
PHCU	: Primary Health Care Unit
PVST	: Post Vaccination Serologic Testing
SCI	: Save the Children International
SMOH	: State Ministry of Health
TB	: Tuberculosis
TDF	: Tenofovir Disproxil Fumarate
TORCH	: Toxoplasma, Rubella, Cytomegalovirus, Herpes Simplex
WHO	: World Health Organization

OPERATIONAL DEFINITION OF KEY TERMS

Antenatal care: It is a public health intervention that deals with the care of women during pregnancy, childbirth, and the recuperative period following delivery.

Hepatitis B surface Antigen: The hepatitis B surface Antigen (HBsAg) is a marker that if found in patient's blood means the person is infected with the virus

Hepatitis B: It is a viral disease that affect human liver and run an acute to chronic cause

Neonatal infection: This refers to passing of infection from the mother or environment during neonatal period.

Seroprevalence: Refers to the proportion of individuals in a population who have specific antibodies against a particular infectious agent or disease. it is a measure of specific antibody in a population indicating the extent of past exposure or infection with a particular pathogen.

Vaccine effectiveness: It refers to power of vaccine to prevent the infection in the body of an immunized person.

Vertical transmission prevention: This refers to measures and strategies put in place to minimize or eliminate the transmission from mother to child

Vertical transmission: Vertical transmission, in the context of maternal and child health, refers to the transfer of an infectious agent from a pregnant woman to her fetus or newborn during pregnancy, childbirth, or breastfeeding. This mode of transmission can occur through various routes, including transplacental (across the placenta), perinatal (during labor and delivery), or postnatal (through breastfeeding).

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter consists of background of the study, statement of problem, objectives of the study, general and specific objectives, research questions, justification, significance and scope of study, limitations, and delimitation of the study.

1.1 Background of the Study

Hepatitis B virus continues to pose significant health challenges globally primarily because it leads to severe liver conditions including hepatocellular carcinoma (HCC), liver failure, and liver cirrhosis. Globally 296 million people live with HBV virus illustrating the substantial burden of HBV. The number of new infections yearly stands at 1.5 million (WHO, 2021). Complications due to HBV resulted in 820,000 deaths in the year 2019. This included 192,000 deaths due to HCC and 331,000 deaths due to cirrhosis. This shows that HBV contributes significantly to global mortality and morbidity (Polaris Observatory Collaborators, 2018). The increasing burden of HBV is exacerbated by various challenges including stigma around liver diseases, lack of adequate preventive measures including vaccination, and underdiagnosis (McMahon et al., 2021).

Globally, there are variations in HBV prevalence across regions. This is due to various factors including socio-economic factors, public health policies, and healthcare access. Among the general population, the HBV prevalence is estimated at 3.5%, however, there are regions with much higher prevalence. For example, in Africa and the Western Pacific regions, the prevalence exceeds 6%, while in America the rates are below 1% (WHO, 2022). In the high-risk groups which include pregnant women, the HBV

prevalence varies greatly ranging from 0.1% in high-income countries to more than 15% in regions like East Asia and Sub-Saharan Africa because of the high burden (Franco et al., 2022; Zhang et al., 2022).

The transmission of Hepatitis B virus (HBV) remains a significant global public health concern, with vertical transmission, or mother-to-child transmission (MTCT), presenting a particularly alarming challenge. This mode of transmission is responsible for approximately 90% of chronic HBV infections in infants, a stark contrast to the less than 5% chronic infection rate observed in adults (Black et al., 2023). The high rate of chronicity in infants underscores the critical importance of implementing effective preventive measures to curb HBV transmission and its long-term health consequences.

Vaccination is widely recognized as one of the most effective tools for preventing HBV transmission, including MTCT. Since the early 1980s, when the World Health Organization (WHO) included HBV vaccination in its Expanded Program on Immunization (EPI), significant progress has been made in integrating this vaccine into national immunization schedules. Today, over 90% of countries worldwide have adopted HBV vaccination programs as part of their routine immunization efforts (WHO, 2021). Despite these achievements, major gaps persist, particularly in the timely administration of the HBV birth dose, a key component of preventing MTCT.

Global coverage of the HBV birth dose vaccination remains unacceptably low. Current data shows that only 42% of newborns worldwide receive the HBV birth dose vaccine within the recommended 24-hour window after birth. This figure highlights significant disparities in vaccination coverage between regions and across income levels. High-income countries achieve a birth dose coverage rate of approximately 80%, reflecting the benefits of strong healthcare infrastructure, effective public health policies, and

greater resource availability. In stark contrast, coverage rates in low- and middle-income countries drop to below 10%, revealing profound inequities in access to essential healthcare services (Black et al., 2023).

The disparity in HBV birth dose vaccination coverage underscores the pressing need for targeted interventions, particularly in resource-limited settings. Several barriers contribute to these low coverage rates, including inadequate healthcare infrastructure, logistical challenges in vaccine distribution, and insufficient awareness among healthcare providers and communities about the importance of timely HBV vaccination. In many low-income regions, the lack of access to skilled birth attendants and health facilities further complicates efforts to deliver the birth dose vaccine within the critical 24-hour period after delivery. This issue is compounded by limited cold chain systems, which are essential for maintaining vaccine potency during storage and transportation.

Financial constraints also play a significant role in limiting access to HBV vaccination in low- and middle-income countries. High out-of-pocket costs for vaccines and related healthcare services deter many families from seeking timely immunization for their newborns. Furthermore, insufficient funding for public health programs often restricts the ability of governments to provide free or subsidized vaccines, leaving vulnerable populations at higher risk of HBV infection. Addressing these financial barriers through expanded funding and international support is crucial for improving birth dose coverage and reducing HBV transmission rates.

Awareness and education are also critical factors in enhancing vaccination coverage. In many communities, there is limited understanding of the importance of the HBV birth dose vaccine in preventing chronic HBV infections and their severe long-term health

impacts. Misconceptions about vaccines, cultural beliefs, and stigma surrounding HBV can further hinder acceptance and uptake of vaccination services. Strengthening public health education campaigns that emphasize the safety and benefits of HBV vaccination can help dispel myths and promote higher coverage rates, particularly in under-vaccinated regions.

Improving HBV birth dose coverage requires a multifaceted approach that addresses these systemic and societal barriers. Governments and international organizations must prioritize investments in healthcare infrastructure to ensure that vaccines are available and accessible to all newborns, regardless of geographic location or socio-economic status. Strengthening cold chain logistics and expanding the availability of skilled birth attendants are essential steps in overcoming logistical challenges. Additionally, integrating HBV vaccination into existing maternal and child health programs, such as antenatal care services, can help ensure timely administration of the birth dose vaccine.

Collaboration between public health agencies, non-governmental organizations, and local communities is vital for implementing effective and sustainable vaccination strategies. International funding and technical assistance can support resource-limited countries in scaling up their vaccination programs and achieving greater equity in HBV prevention. Furthermore, monitoring and evaluation systems should be enhanced to track vaccination coverage and identify gaps, enabling timely adjustments to policies and programs.

The African region bears a disproportionately large share of the global burden of the HBV epidemic, accounting for nearly 65 million of the 296 million cases reported worldwide (Franco et al., 2022). This makes the continent a focal point for intervention and research efforts aimed at mitigating HBV's impact. The prevalence of chronic HBV

infection in Africa stands at 4.5%, which is significantly higher than the global average, underscoring the severity of the issue. Moreover, certain areas in sub-Saharan Africa are classified as endemic, with prevalence rates soaring above 8%, highlighting the need for region-specific strategies to combat the epidemic (WHO, 2021). Among pregnant women in the African region, the prevalence of HBV infection ranges between 6% and 15%. This alarming rate poses a heightened risk for vertical transmission, leading to a considerable likelihood of newborns developing chronic HBV infections. Such infections in early life contribute substantially to the long-term burden of disease in the region (Nankya-Mutyoba et al., 2021). The interplay of high prevalence rates and the risk of mother-to-child transmission calls for immediate public health action, including enhanced vaccination campaigns and targeted prevention strategies for high-risk populations.

Systemic barriers have significantly impeded the success of vaccination efforts aimed at controlling HBV transmission in the African region. While the majority of African countries have incorporated HBV vaccination into their national immunization schedules, the timely administration of these vaccines remains a persistent challenge (WHO, 2021). One of the primary reasons for this gap is the low level of public awareness regarding HBV prevention, which limits community engagement and acceptance of vaccination programs. Additionally, weak healthcare infrastructure, particularly in maternal and child health services, exacerbates the problem by hindering the effective delivery of vaccines (Jaquet et al., 2021).

The consequences of these systemic challenges are starkly reflected in health outcomes. Liver cancer, a condition predominantly caused by chronic HBV infection, has become the third leading cause of cancer-related deaths in Africa. This alarming statistic underscores the critical need for focused interventions to address HBV transmission

and its long-term impacts (WHO, 2021). Such interventions must include widespread public health campaigns to raise awareness, investments in strengthening healthcare infrastructure, and efforts to ensure the timely administration of HBV vaccines, especially the birth dose, to break the cycle of transmission. These measures are essential for reducing the burden of HBV-related diseases and improving public health outcomes in the region.

South Sudan is one of the countries grappling with an exceptionally high burden of hepatitis B virus (HBV), with prevalence rates in the general population estimated to be between 10% and 15% (Martyn et al., 2023). This rate is particularly concerning in certain high-risk groups, such as pregnant women, where a significant 26% test positive for HBsAg, further amplifying the potential for vertical transmission of the virus. This poses a serious public health challenge, as the risk of mother-to-child transmission is heightened, leading to increased chronicity of the infection in the next generation. Additionally, the issue of neonatal HBV infections is particularly alarming, with transmission rates exceeding 55.5% among infants born to mothers who are HBsAg-positive (Martyn et al., 2023). These figures underscore the urgent need for comprehensive and targeted intervention strategies to prevent vertical transmission, including enhanced vaccination programs, timely administration of the HBV birth dose, and robust maternal screening. Without such efforts, the future burden of HBV-related morbidity and mortality in South Sudan is likely to remain high, with long-term public health consequences.

The healthcare challenges in South Sudan significantly exacerbate the already critical situation regarding hepatitis B virus (HBV) transmission. Vaccination coverage, particularly for the HBV birth dose, remains exceedingly low due to a combination of ongoing political instability, inadequate healthcare infrastructure, and limited

community awareness about the virus and its prevention (WHO, 2021). These systemic issues severely impede the effective delivery of vaccination programs, further perpetuating the cycle of HBV transmission.

In addition to these barriers, the scarcity of diagnostic tools and antiviral treatments heightens the risk of untreated individuals progressing to advanced liver disease, including cirrhosis and liver cancer. The limited availability of these medical resources exacerbates the public health burden, as individuals with chronic HBV infection are often undiagnosed and untreated. Compounding the situation is the lack of adequate training for healthcare workers, which leaves them ill-equipped to diagnose, manage, and treat HBV effectively. Furthermore, the absence of widespread maternal screening programs further weakens the response to HBV, particularly in preventing vertical transmission from mothers to infants (Jaquet et al., 2021). These systemic deficiencies demand urgent and coordinated efforts to strengthen healthcare infrastructure, improve training for healthcare providers, and enhance public health campaigns to raise awareness about HBV prevention and treatment. Only through such efforts can South Sudan hope to mitigate the devastating impact of HBV on its population.

1.2 Problem Statement

Hepatitis B is a major concern globally, leading to severe damage to the liver which includes liver cancer and cirrhosis hence increasing mortality rates significantly (WHO, 2021). Despite vaccine availability, there is still a high prevalence of Hepatitis B in most regions including South Sudan. Hepatitis B is caused by the Hepatitis B virus (HBV), and vertical transmission (mother-to-child) is a major mode of infection, especially in high-endemicity areas like South Sudan. This raises concerns about the effectiveness of current vaccination strategies in preventing such transmission.

In certain regions, evidence suggests that Hepatitis B infection continues to rise despite the population being vaccinated. However, there is limited data specific to the South Sudan region, especially on Hepatitis B prevalence among individuals who have been vaccinated and the rate of vertical transmission from the mother to child (Chang et al., 2012; WHO, 2021). Understanding the seroprevalence of Hepatitis B among pregnant women and evaluating the vaccine's efficacy in preventing vertical transmission is essential for addressing these gaps. Existing research has not sufficiently investigated these issues in South Sudan, leaving policymakers and healthcare providers without the evidence required to design effective interventions.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study was to evaluate the effectiveness of Hepatitis B vaccine in preventing vertical transmission of the virus from mother to child among pregnant women in antenatal clinics in Abyei South Sudan.

1.3.2 Specific Objectives

i. To determine viral hepatitis B seroprevalence among pregnant women seeking antenatal services in antenatal clinics in Abyei, South Sudan
ii. To assess awareness of Hepatitis B among pregnant women at antenatal clinics in Abyei, South Sudan.
iii. To investigate risk factors associated with viral hepatitis B prevention among pregnant women at antenatal Clinics in Abyei, South Sudan
iv. To assess barriers and challenges associated with viral hepatitis B prevention among pregnant women at antenatal Clinics in Abyei, South Sudan
v. To evaluate the effectiveness of hepatitis B vaccine in preventing mother-to-

child transmission among pregnant women at antenatal Clinics in Abyei, South Sudan

1.4 Research Questions

i. What is the seroprevalence of viral Hepatitis B among pregnant mothers at antenatal clinics in Abyei, South Sudan?
ii. What is the level of awareness of hepatitis B among pregnant mothers at antenatal clinics in Abyei, South Sudan?
iii. What are the risk factors associated with viral hepatitis B prevention among pregnant mothers at antenatal Clinics in Abyei, South Sudan?
iv. What are barriers and challenges associated with viral hepatitis B prevention among pregnant mothers at antenatal Clinics in Abyei, South Sudan?
v. What is the effectiveness of Hepatitis B vaccine in preventing mother-to-child transmission among pregnant mothers at antenatal Clinics in Abyei, South Sudan?

1.5 Research Hypothesis

Null Hypothesis: There is no difference in the rate of mother-to-child transmission of hepatitis B virus (HBV) between infants of HBsAg positive mothers who receive the hepatitis B vaccine and those whose mothers are negative and have also received the vaccine.

1.6 Justification of the study

Viral Hepatitis B remains a public health threat in South Sudan with high prevalence rates and inadequate information about the effectiveness of vaccines. It is particularly important to determine the seroprevalence of the Hepatitis B virus and the effectiveness of vaccination in preventing vertical transmission. Such knowledge will tackle one of

the critical health challenges in the region effectively, and in the long run, maternal and child health will improve. Focusing on these aspects, the research will generate such data that will assist in developing specific population-based public health measures (WHO, 2021).

There is an apparent deficit in the existing literature on Hepatitis B in South Sudan. The information is scarce on the level of the disease to immunize individuals as well as the level of the disease transmission from mother to the child. The inadequate information limits how effective health programs or strategies can be formulated. By dealing with these issues, this study intends to generate evidence that can enable evidence-based interventions in policymaking among the vulnerable (Chang et al., 2021).

This study's results will have a big impact on policy. It will help to create actionable public health plans such as stronger vaccine drives, better care for pregnant women, and cut down on mother-to-child spread. These steps are key to lessening how much Hepatitis B affects people, mothers, and babies in areas where it's common (WHO, 2021). Also, this study fits with worldwide goals to eradicate Hepatitis B as a major health problem by 2030. The World Health Organization's plans for dealing with viral hepatitis worldwide illustrate how important it is to lower the number of new Hepatitis B cases and deaths through vaccination and prevention programs. Therefore, the study tackles both local and international health priorities (WHO, 2021).

1.7 Study significance

Hepatitis B is a global public health issue and data is required to inform interventions by region. In South Sudan, data is limited especially on the prevalence of Hepatitis B among pregnant women and the effectiveness of vaccination programs in preventing vertical transmission. This study will fill this gap and provide localized evidence to

inform health policies and interventions. The results will inform maternal and child health strategies, e.g. integrating Hepatitis B screening and vaccination into antenatal care services to improve outcomes for vulnerable populations.

The study also has a public health significance as it will identify gaps in the prevention and control of Hepatitis B in South Sudan. By determining the seroprevalence and vaccine effectiveness, this study will highlight areas that need immediate attention such as vaccine access, health education and improved maternal health services. This is in line with the overall goal of reducing the disease burden and improving outcomes for mothers and infants especially in hard-to-reach areas.

Furthermore, the study will contribute to several Sustainable Development Goals (SDGs). For example, it will support SDG 3 (Health and Well-being) by enhancing maternal and child health through targeted vaccination and prevention of vertical transmission. It will also address SDG 10 (Reduced Inequalities) by focusing on equitable health policies that prioritize vulnerable populations such as pregnant women and infants who are disproportionately affected by Hepatitis B. And the study will promote SDG 17 (Partnership for the Goals) by bringing together policymakers, health providers, researchers and international organizations to strengthen collective efforts against Hepatitis B.

The results will have policy implications by informing national health policy development and refinement. For example, they can support integration of Hepatitis B screening and vaccination into routine antenatal care services to increase coverage and effectiveness of maternal health programs. The evidence generated from this study will also be used to advocate for increased funding and resources for public health programs on Hepatitis B prevention and management.

Finally, the study will benefit many stakeholders. Pregnant women and their infants will directly benefit from improved access to prevention and treatment programs. Health providers will have evidence-based strategies to guide their clinical decisions, policymakers will have the data to inform their health interventions and researchers will have a resource to further explore Hepatitis B issues in South Sudan. By addressing these needs the study will not only fill the knowledge gap but also strengthen the health system's capacity to manage and prevent Hepatitis B and ultimately improve health outcomes for communities in South Sudan.

1.8 Scope of the Study

1.8.1 Geographical Scope

The study was conducted within the Abyei Special Administrative Area, focusing on two specifically selected health facilities to ensure comprehensive data collection and representation. Among these, Abyei Primary Health Care Centre and Ganga Primary Health Care Unit were notably included due to their strategic significance and service reach within the Abyei Administrative Area of South Sudan. This selection aims to encompass a broad yet focused geographical scope that reflects the healthcare infrastructure and patient demographics relevant to the study's objectives. By including these facilities, the study seeks to capture a nuanced understanding of the healthcare dynamics and the prevalence of health conditions within the region.

1.8.2 Content Scope

The research was primarily focused on pregnant women who were attending prenatal clinics in Abyei, South Sudan, as the target group. The objective of the study was to investigate the seroprevalence of hepatitis B infection among pregnant women attending antenatal clinics in Abyei, South Sudan. The objective of this study was to ascertain the

prevalence of hepatitis B surface antigen (HBsAg) seropositivity among pregnant women and evaluate the impact of the illness within this specific demographic. The primary objective of this study was to assess the efficacy of the hepatitis B vaccination in mitigating the vertical transmission of the virus from the maternal host to the neonate. The objective of this study was to ascertain the transmission rate of hepatitis B from women who are infected to their newborns, while also evaluating the potential protective impact of administering the hepatitis B vaccination during pregnancy.

1.8.3 Time scope

The study span from the period covering data collection to the phase of data analysis and took six (8) months. The study took place from the month of September 2023 to the month of May 2024. This time was convenient as access to some parts of the study area improved and the research team can easily move to collect the data.

1.9 Limitations of the Study

The study was limited to a section of the population seeking care during the time of the study period. This was addressed through selection of facilities from different axis of the area to ensure that representative of different localities is covered. The patients may provide incomplete and inaccurate information during the interview. Knowledge and experience of senior health workers was relied on to ensure that the information provided by the interviewees are complete and correct.

Child born of infected mothers who are positive of hepatitis B were followed up to ensure that they completed the three dosages of vaccination, some lost track due to factors like displacement, migration to other locations or death. Contacts details were used to ensure that mothers were followed up until their children completed the vaccination by the health promoters and the community health volunteers and using their phone numbers.

Some mothers may deliver at home due to some reasons. Expectant mothers registered had their expected dates of delivery reviewed continuously to ensure that they were linked to the facilities and when found delivered at home their children taken to the facility for vaccination as per schedule

1.10 Delimitation of the Study.

Below are specific boundaries that the researcher sets for the study as research delimitations:

Geographic delimitation: The study only focused on pregnant women attending antenatal clinic in Abyei area and did not cover other counties or States in South Sudan.

Sample size: The study only included 384 pregnant women attending antenatal clinic in Abyei and did not cover all pregnant women in the area.

Time period: The study only covered a specific period for data collection and analysis and did not capture data from previous years.

Language: The study was translated from English and conducted in Dinka and Arabic Language, and not include other languages.

Hepatitis B subtype: The study only focused on Hepatitis B surface antigen (HBsAg) biomarker and did not cover other subtypes

1.11 Assumption of the study

High Hepatitis B Seroprevalence: The study presumes that the prevalence of Hepatitis B infection is notably high among pregnant women seeking antenatal care in the chosen study area. This assumption underscores the critical importance of understanding the patterns and implications of Hepatitis B in this demographic, given the potential for transmission from mother to child.

Impact of Vaccination on Transmission: The study further assumes that administering the Hepatitis B vaccine can significantly reduce the rate of mother- to-child transmission of the virus. This assumption is based on existing scientific evidence that vaccination is effective in preventing the transmission of Hepatitis B from infected mothers to their infants, which can have lifelong health implications for the child. The study aims to further substantiate this by evaluating the effectiveness of vaccination strategies in the study location.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter is composed of literature review under the following, empirical literature review, study objectives review, theoretical literature review, theoretical framework and conceptual framework.

2.1 Empirical Literature review

2.1.1 Hepatitis situation globally

It is estimated that approximately 296 million people worldwide are living with chronic HBV infection (WHO, 2021). The prevalence of chronic HBV infection varies widely by region, with the highest prevalence rates observed in sub-Saharan Africa and the Western Pacific region. HBV infection is a major cause of liver-related morbidity and mortality, accounting for approximately 820,000 deaths annually. Complications of chronic HBV infection, such as cirrhosis and liver cancer, contribute to the high mortality associated with the disease (WHO, 2021). The burden of HBV infection places considerable strain on healthcare systems, with substantial economic costs associated with the management of chronic liver disease and its complications.

The burden of HBV is especially high in Asia, where it is endemic in many countries. In Asia, the prevalence rate of HBV varies greatly among regions and population groups. Eastern and Southeast Asia have some of the highest prevalence rates in the world, with over 10% of the adult population being chronic carriers in some areas. This is significantly higher than the global average prevalence rate, which is estimated to be around 3.5%. In certain high-risk groups, such as those with a family history of HBV or those who are immunocompromised, the prevalence rate can be even higher (WHO,

2017). The high prevalence of HBV in Asia has significant health and economic impacts. HBV is a major cause of liver disease, including hepatocellular carcinoma (HCC) and cirrhosis, both of which are associated with high mortality rates. According to the Global Cancer Observatory, more than half of the global cases of HCC occur in East Asia, highlighting the significant burden of HBV-related liver disease in this region. The economic burden of HBV in Asia is also substantial. The costs associated with HBV include not only the direct costs of medical care but also indirect costs such as lost productivity due to illness and premature death (Gnyawali et al., 2022).

On the other hand, the countries that exhibited the lowest incidence rate of AHB were the United States of America, Cuba, and Latvia. Notably, the largest burden of AHB surpassed the lowest burden by a factor of more than 70. Certain countries had the most significant prevalence of AHB incidence rates, including Afghanistan (155.0 [42.9–329.9] per 100,000 person-years) and Somalia (Wang, 2017). These countries also shown the highest burden of AHB DALY rates. Subsequent investigations have revealed that the United States of America had the most minimal burden in terms of age-standardized DALY rates of AHB, with a rate of 0.6 [0.4–0.7] per 100,000 person-years.The decline in the incidence of acute hepatitis B (AHB) in the European Union can be attributed to the implementation of the hepatitis B virus (HBV) vaccine (Wang, 2017).

The Western Pacific and Africa areas have the greatest prevalence rates of HBV infection, with corresponding proportions of 6.2% and 6.1% among the adult population (Kayondo et al., 2020). In contrast, the prevalence of the American area is the lowest, accounting for 0.7% of the population. According to research by the World Health Organization in 2017, while acute hepatitis B (AHB) typically cures spontaneously,

chronic hepatitis B (CHB) may arise because of reduced antiviral effect or cell activity originating from AHB.

The low frequency of viral hepatitis B in industrialized countries, particularly in Europe, might perhaps be attributed to the high socioeconomic status prevalent in these regions. Consequently, the prevalence of Hepatitis B can serve as an indicator for assessing the potential risk factors associated with the transmission of viral Hepatitis B (Tosun et al., 2018). These risk factors encompass several modes of transmission, such as the use of contaminated needles during medical procedures, industrial accidents, the use of body tattoos, and a lack of vaccination history, among other identified concerns. Viral hepatitis is an infectious disease characterized by hepatic inflammation. Various viruses, such as hepatitis B and C viruses, have the potential to induce this condition. According to Ali et al. (2018), both Viral Hepatitis B and C have the potential to induce acute and chronic infections, making them significant contributors to the development of liver cirrhosis and hepatocellular cancer.

2.1.2 Hepatitis B Situation in Africa

Africa bears a significant burden of chronic Hepatitis B virus infection, with an estimated prevalence of 6.1% among the general population (WHO, 2021). The prevalence of chronic HBV infection varies widely across different countries and regions within Africa, with some areas experiencing much higher rates than others. Sub-Saharan Africa has the highest prevalence of HBV infection globally, with some countries reporting prevalence rates exceeding 8% (WHO, 2021). Within sub- Saharan Africa, the prevalence of HBV infection tends to be highest in West Africa, followed by Central and East Africa. Perinatal transmission of HBV from infected mothers to their infants is

a major route of transmission in Africa, contributing significantly to the high prevalence of infection (WHO, 2021).

In sub-Saharan Africa, an estimated 5-10% of newborns are infected with HBV through perinatal transmission, resulting in a high burden of chronic infection in childhood and adulthood (WHO, 2021). The burden of HBV infection in Africa places a considerable strain on healthcare systems, with limited resources available for prevention, testing, and treatment services (Ofori-Asenso & Agyeman, 2016). Chronic HBV infection contributes to liver-related morbidity and mortality, including cirrhosis and hepatocellular carcinoma, further exacerbating the burden on healthcare systems (Ofori-Asenso & Agyeman, 2016). Despite the high burden of HBV infection in Africa, there have been significant efforts to scale up vaccination programs and improve access to testing and treatment services in recent years (WHO, 2021). Challenges such as limited healthcare infrastructure, inadequate funding, and competing health priorities continue to pose barriers to effective hepatitis B control in Africa (Ofori-Asenso & Agyeman, 2016).

Liver cancer is prevalent in the West African region. However, there is a scarcity of information on hepatitis B, a viral infection that is believed to be responsible for around 80% of primary liver malignancies on a global scale. A significant proportion of families in Senegal have experienced the loss of a family member due to liver cancer. Most families often have at least one uncle or cousin impacted by a certain condition or circumstance. However, there is a lack of discourse about hepatitis B in the countries (Amponsah-Dacosta, 2021).

Senegal's lack of attention to hepatitis B care is not an isolated occurrence. According to the World Health Organization (WHO), the prevalence of diagnosed chronic hepatitis B

infection among Africans is reported to be as low as 2%, with a far lower proportion of individuals, around 0.1%, receiving appropriate treatment. In contrast, the percentages in Europe and the Americas are reported to be 18-19% and 2-3% respectively (WHO, 2021). The continent exhibits a deficiency in comparison to other regions worldwide in terms of its efforts to mitigate hepatitis B through immunization. According to Safadi et al., (2021), the percentage of newborn infants who get birth-dose immunizations, which are effective in preventing the transfer of the virus from mother to child, is around 11%. This, combined with maternal screening, is considered the most expeditious approach to reducing the prevalence of the virus within a community.

A study by CDC on the rate of new hepatitis B cases reported to CDC among persons aged 18–40 years decreased from 1.4 cases per 100,000 populations in 2017 to 0.7 in 2020, below the target rate of 1.3 per 100,000 population. The study in Sub-Sahara Africa attributed the abrupt decline attributable to major disruptions in access to medical care, testing, and routine viral hepatitis public health activities due to the COVID-19 pandemic (Conners et al., 2023). Therefore, 2020 data should be interpreted with caution. Injection drug use is the most common risk reported for persons aged 18–40 years with new hepatitis B virus infections in the United States. The 2020 rate of reported new hepatitis B cases is 30% below the 2025 goal of 1.0 case per 100,000 population, however, the decline observed in 2020 may not continue in subsequent years once testing and health department case investigation resume regular operations (Conners et al., 2023).

2.1.3 Hepatitis B Virus Situation in East African Context

In East Africa, the prevalence of chronic HBV infection varies across countries, with some areas experiencing higher rates than others (Noubiap et al., 2015). Studies

conducted in countries such as Ethiopia, Kenya, Tanzania, Uganda, and Rwanda have reported prevalence rates ranging from 4% to over 8% among the general population (Noubiap et al., 2015; Ocama et al., 2015). Within East Africa, there is variation in the prevalence of HBV infection between urban and rural areas, as well as between different population groups (Ocama et al., 2015; Noubiap et al., 2015).

Factors such as socioeconomic status, access to healthcare, and cultural practices may contribute to t perinatal transmission of HBV is a major route of transmission in East Africa, contributing significantly to the high prevalence of infection (Ocama et al., 2015).

Studies have shown that a significant proportion of HBV infections in East Africa occur through mother-to-child transmission during childbirth or early infancy (Ocama et al., 2015; Noubiap et al., 2015). The disparities in HBV prevalence observed within the region (Noubiap et al., 2015). The burden of HBV infection in East Africa poses significant challenges for healthcare systems, including limited resources for prevention, testing, and treatment services (Ocama et al., 2015).

Chronic HBV infection contributes to liver- related morbidity and mortality in the region, further straining healthcare infrastructure and resources (Ocama et al., 2015; Noubiap et al., 2015). Efforts to control HBV in East Africa include vaccination programs, improved access to testing and treatment services, and public health campaigns to raise awareness about the disease (Ocama et al., 2015; Noubiap et al., 2015). However, challenges such as limited funding, inadequate healthcare infrastructure, and competing health priorities continue to hamper efforts to effectively address the HBV burden in the region (Noubiap et al., 2015).

Estimations from the World Health Organization (WHO) 2021 suggest that Kenya bears a Hepatitis B prevalence exceeding 8%. To address this pressing public health challenge, the integration of the Hepatitis B vaccine into the Kenya Expanded Program of Immunization (KEPI) was initiated in 2013, with vaccine administration scheduled at 6-, 10-, and 14-weeks following birth. However, a notable challenge persists while the immunization program provides complimentary vaccination services for children up to 5 years old, it fails to extend this support to individuals falling within other high-risk categories.

A study conducted in Uganda highlighted that perinatal transmission of HBV is estimated to range from 1% to 5%. Moreover, a substantial portion of the Ugandan population, approximately 72%, encounters hepatitis B at some point in their lives, culminating in a national prevalence of approximately 10% for hepatitis B infection (Mugabiirwe et al., 2022). Regional disparities are evident within Uganda, with the northern region exhibiting the highest prevalence rates. Prevalence rates in the northern part of the country range from 19% in the northwest to 25% in the northeast. Despite these regional variations, specific figures for the number of pregnant women testing positive for hepatitis B worldwide remain unknown. However, in Northern Uganda specifically, the prevalence stands at approximately 11.8%. Nonetheless, it is essential to note that this study faced several limitations concerning participant recruitment and the accurate estimation of mother-to-child transmission risk, as highlighted by Kayondo et al., 2020.

Tanzania is classified as a higher-endemic country for hepatitis B. A seroprevalence study conducted in Dar es Salaam reported a 6% prevalence of HBV infection in the general population. This rate represents an increase from previous studies, which recorded a prevalence of 4.4% in the same population (Kilonzo et al., 2018). Notably,

lower infection rates have been observed among children. Additionally, rates of 4.3% and 1.8% were noted in Iringa and Pemba, respectively, among children presenting with febrile syndromes at healthcare facilities. The decline in seropositivity rates among children, particularly those born after the year 2002, can be attributed to the introduction of the HBV vaccine in the country. This intervention has been accompanied by consistently satisfactory immunization coverage, as highlighted by Kilonzo et al., (2018). This illustrates the importance of preventive measures in mitigating the spread of hepatitis B and its associated risks.

In Rwanda, data regarding HBV prevalence is predominantly available for specific population subgroups. For instance, one study conducted among 13,121 pregnant women across 30 sentinel sites revealed a HBsAg prevalence of 3.7%. Similarly, a recent study involving 117,258 people living with HIV (PLHIV) reported a prevalence of HBsAg at 4.3%. However, comprehensive epidemiological data concerning HBV in the general population remains limited. Nonetheless, a nationwide campaign targeting a total of 327,360 individuals was conducted, revealing an overall HBsAg positivity rate of 3.9%,

as outlined by Makuza et al., (2019). Both Burundi and Rwanda are categorized as countries with an intermediate burden of viral hepatitis B and C. In Burundi, the HBsAg prevalence has been estimated at 4.6%. These findings underscore the importance of further research and comprehensive public health interventions to address the prevalence and impact of hepatitis B in these regions.

In the Democratic Republic of Congo (DRC), the national prevalence of HBV is estimated to be 3.3% based on HBV surface antigen (HBsAg) testing, indicating roughly

2.5 million chronic infections in a country where access to advanced hepatology care is largely unattainable (Morgan et al., 2023). However, certain population groups within

the DRC exhibit higher estimated prevalence rates, including blood donors, women with HIV attending urban antenatal care (ANC) settings, pregnant women in rural areas, healthcare workers, and survivors of sexual violence.

Historical data sheds light on the evolving prevalence of HBV among Somali blood donors. Reports from 1995 indicated a prevalence of 19.0%, a figure that decreased to 2.1% by 2023. Additionally, a meta-analysis unveiled an 18.9% pooled HBV prevalence among the general population in Somalia (Mohamud et al., 2024). Moreover, 7.3% of hemodialysis patients were found to be HBV-positive. Despite these statistics, studies exploring associated risk factors remain scarce. Acquiring up-to-date information on such risk factors is pivotal for ensuring a safe blood supply and mitigating the risk of spreading blood-borne infections, particularly HBV.

2.1.4 Hepatitis B in South Sudan

The burden of hepatitis B in South Sudan presents a significant public health challenge, with substantial implications for healthcare systems and population health. According to studies, the prevalence of hepatitis B surface antigen (HBsAg) in South Sudan ranges from 16% to 20%, indicating a high endemicity of the virus within the population (Badawi et al., 2018). This high prevalence underscores the urgent need for comprehensive prevention and control measures to curb the transmission and impact of hepatitis B in the country.

The burden of hepatitis B extends beyond mere prevalence rates, encompassing a spectrum of acute and chronic complications, including liver cirrhosis and hepatocellular carcinoma. The global prevalence of hepatitis B virus (HBV) infection has exceeded 2 billion individuals, with an estimated annual mortality rate of 1 million people attributed to acute and chronic consequences of HBV infection (Badawi et al., 2019). Such

complications not only pose significant health risks to affected individuals but also strain healthcare resources and contribute to increased morbidity and mortality rates.

Efforts to address the burden of hepatitis B in South Sudan must prioritize comprehensive vaccination programs, screening initiatives, and access to treatment and care services. Vaccination against HBV has demonstrated sustained efficacy in reducing the incidence of both acute and chronic HBV infections, highlighting the importance of widespread immunization efforts (Kheir et al., 2018). Additionally, screening programs targeting high-risk populations, such as pregnant women and individuals with a history of intravenous drug use, are essential for early detection and intervention. Furthermore, enhancing public awareness and understanding of hepatitis B transmission, prevention, and treatment is crucial for fostering community engagement and empowering individuals to take proactive measures to protect their health (Kheir et al., 2018). By addressing the burden of hepatitis B comprehensively, South Sudan can mitigate the impact of the virus on population health and work towards achieving better health outcomes for its citizens.

2.1.5 Hepatitis B Diagnosis

The diagnosis of Hepatitis B virus entails the identification of indicators of hepatic impairment, such as jaundiced skin or abdominal discomfort. Blood tests are utilised as diagnostic tools for hepatitis B and its associated consequences. These tests are capable of identifying indicators of the hepatitis B virus inside the human body, so enabling healthcare providers to determine if the infection is acute or chronic (Ahmad et al., 2019).

Healthcare practitioners may conduct hepatitis B infection tests on asymptomatic individuals due to the potential liver damage caused by the virus prior to the manifestation of clinical signs and symptoms (Kheir et al., 2018). The target

populations for Hepatitis B virus screening encompass pregnant women, individuals residing with hepatitis B carriers, those who have engaged in multiple sexual partnerships, individuals who have had sexual intercourse with hepatitis B-infected individuals, men who have sex with men, individuals with a previous sexually transmitted infection, individuals with HIV or hepatitis C virus, and individuals who have undergone a liver enzyme test showing unexplained abnormal outcomes (Badawi et al., 2018).

According to Hussain & Khan (2018), certain research findings indicate that individuals undergoing renal dialysis treatment may concurrently be prescribed immunosuppressive drugs, which are commonly used to avoid organ rejection following transplantation. Several studies have recognized the use of illicit intravenous substances among incarcerated individuals, particularly in regions with a high prevalence of hepatitis B, such as Asia, the Pacific Islands, Africa, and Eastern Europe. Additionally, it has been observed that individuals in these settings may have either biological offspring or adopted children originating from regions where hepatitis B is prevalent (Hussain & Khan, 2018).

The hepatitis B virus can infect individuals across several age groups, including newborns, children, adolescents, and adults. The condition in question does not possess a hereditary etiology; rather, it is an infectious ailment that is disseminated by blood transmission. While it is true that everybody may face the possibility of contracting hepatitis B at some point in their lives, certain populations are more susceptible due to factors such as their place of birth, career, or lifestyle choices (Kheir et al., 2022).

2.1.6 Hepatitis B Transmission

The transmission of the hepatitis B virus is primarily facilitated through the exchange of bodily fluids containing the virus, most commonly through blood and sexual fluids. This viral transmission can manifest through various primary modes, each presenting distinct pathways for infection. Direct exposure to infected blood, such as through sharing needles or receiving contaminated blood transfusions, poses a significant risk of Transmission (Marseille et al., 2021).

Additionally, vertical transmission from an infected pregnant individual to their unborn child during pregnancy and childbirth represents another critical route of infection, underscoring the importance of prenatal screening and preventative interventions. Furthermore, the use of contaminated or non-sterile medical or dental equipment and procedures can serve as vectors for transmission, highlighting the necessity of stringent infection control measures in healthcare settings (Marseille et al., 2021). Lastly, engaging in unprotected sexual intercourse with an infected individual can also facilitate the spread of the virus, emphasizing the importance of practicing safe sex practices and utilizing barrier methods to mitigate transmission risks (Miyakawa et al., 2021).

2.1.7 Vertical transmission of Hepatitis B

Vertical transmission refers to the spread of the hepatitis B virus from an infected mother to her kids during the stages of pregnancy, delivery, or lactation. The aforementioned mode of transmission is of special concern due to its potential to result in significant adverse outcomes for the fetus or neonate. Comprehending the processes underlying mother-to-child transmission (MTCT) is crucial in the effective management of chronic hepatitis B virus (HBV) infection. The primary method of HBV transmission has been identified as perinatal transmission (Miyakawa et al., 2021). There exist three potential modes of transmission: There are three primary

modes of hepatitis B virus (HBV) transmission: trans-placental transmission during pregnancy (referred to as intrauterine transmission), transmission during the process of childbirth (known as intrapartum transmission), and transmission after birth through various means such as caregiving or breastfeeding (referred to as postpartum transmission) (Mudji et al., 2021).

The primary factor contributing to the ineffectiveness of passive-active immune-prophylaxis non-preventing mother-to-child transmission (MTCT) is the spread of hepatitis B virus (HBV) within the uterus. Various diagnostic criteria have been utilised

in the identification of intrauterine infection caused by the hepatitis B virus (HBV). Given the lack of consensus about the diagnostic criteria for intrauterine infection caused by the hepatitis B virus (HBV), many methods have been employed to provide evidence of the presence of HBV components in the serum of infants (Wang, 2017). The precise method by which HBV is transmitted intrauterine has yet to be fully elucidated. The hypotheses most cited pertain to the transmission of the virus through serum or body fluids. This transmission typically occurs in situations where the placenta is damaged due to uterine muscle contractions, such as in cases of threatened abortion, or as a result of invasive procedures performed on the uterus during pregnancy, such as amniocentesis (Mudji et al., 2021).

Additionally, specific infections, such as those caused by TORCH pathogens (Toxoplasma, Rubella, Cytomegalovirus, and Herpes Simplex), Cellular transmission encompasses the transfer of hepatitis B virus (HBV) from the maternal side to the foetal side through placental cells, as well as the transmission of infected peripheral blood mononuclear cells (PBMC) from the maternal circulation system to the fetal circulation system. On the other hand, genetic transmission involves the infection of germ cells such

as sperm and oocytes by HBV, leading to the transmission of the virus to the embryo (Zhao et al., 2022).

Numerous pieces of evidence have shown that elevated levels of HBV DNA in the bloodstream and the presence of HBeAg in pregnant women are significant indicators of an augmented likelihood of mother-to-child transmission (MTCT) of HBV. This risk is most pronounced in cases of intrauterine transmission, which occurs through the transfer of HBV via villous capillary endothelial cells. The study conducted by Roma et al., (2023) has demonstrated a transmission rate of 9% among neonates delivered to women with a viral load more than 8 log10 copies/ml (equivalent to 7.3 log10 IU/ml). This transmission occurred despite the administration of normal passive active immune-prophylaxis, and no transmission was observed below this specified threshold. In recent research, there have been suggestions to establish a lower threshold of 6 log10 copies/ml (5.3 log10 IU/ml) for maternal viremia as the cutoff point. The reported rates of mother-to-child transmission (MTCT) of hepatitis B virus (HBV) to infants varied between 8% and almost 30% when maternal HBV DNA levels above 6 log10 copies/ml (5.3 log10 IU/ml) (Roma et al., 2023).

The presence of Hepatitis B e antigen (HBeAg) positive is an additional autonomous risk factor for the mother-to-child transmission (MTCT) of Hepatitis B virus (HBV). Indeed, HBeAg has the ability to traverse the placenta by means of partial placental leakage or by the "cellular route". The lack of HBeAg expression is correlated with reduced viral replication and a greatly decreased likelihood of intrauterine transmission of the hepatitis B virus (HBV) (Zhao et al., 2022). The aforementioned studies suggest that the use of nucleoside/nucleotide analogues as antiviral medication can lead to a reduction in HBV viral levels, perhaps resulting in a decreased likelihood of intrauterine transmission. Furthermore, the occurrence of perinatal infection with immune-prophylaxis was seen

in 0.4% (with a range of 0.0–2.5%) among infants delivered to women who are carriers of HBeAg- negative. Prior research has indicated that newborns of anti-HBe-positive women are only at risk of infection if the moms have elevated levels of HBV viremia. According to the study conducted by Zhao et al. (2022), intrapartum transmission, which pertains to transmission that occurs during the process of birthing, is widely acknowledged as the primary pathway by which mother-to-child transmission (MTCT) of the hepatitis B virus (HBV) takes place in its natural condition. During the course of childbirth, neonates may potentially come into contact with maternal bodily fluids or blood that carries the hepatitis B virus (HBV) when they traverse the maternal vaginal canal. Furthermore, in the event of a potential preterm labour, the uterine contractions may lead to the tearing of the placenta, leading to the infiltration of maternal blood into the foetal circulation.

Puerperal transmission refers to the spread of the hepatitis B virus (HBV) resulting through contact with maternal breast milk, bodily fluids, blood, or other forms of intimate contact between infants and mothers following childbirth. It is considered less significant compared to previously stated transmission channels due to its low occurrence following the implementation of universal passive-active immune-prophylaxis in neonates born to women who test positive for HBsAg (Zhao et al., 2022).

2.1.8 Prevention Hepatitis B infection after exposure

It is recommended that those who have been exposed to the hepatitis B virus rapidly seek medical attention from their healthcare provider. The comprehension of an individual's hepatitis B vaccination status has considerable significance (Weston et al., 2016). When evaluating a patient's medical state, healthcare personnel often question about the time and characteristics of the individual's exposure. According to a study conducted by

Weston et al., (2018), the timely delivery of immunoglobulin, especially an antibody, within a 24-hour period after being infected with the hepatitis B virus, has the potential to provide protection against the onset of sickness. Prior research has shown that due to the restricted duration of its protective properties, it is recommended to deliver the hepatitis B vaccine simultaneously with this drug in situations where it has not been previously given (Roma et al., 2023).

The provision of immune prophylaxis to babies has shown a substantial reduction in the incidence of perinatal transmission of hepatitis B virus (HBV). The introduction of universal infant vaccination has led to a substantial decline in the prevalence of HBsAg, with rates dropping from 9-12% to below 1% in China (Veronese et al., 2021). Multiple research, including Cochrane systematic reviews, have provided evidence indicating that vaccination in isolation is not enough for effectively preventing the transfer of hepatitis B virus (HBV) from mother to child (MTCT) in women who test positive for HBsAg. In contrast, research has shown that the use of both the Hepatitis B vaccination and HBIG (hepatitis B immune globulin) in conjunction exhibits more efficacy in reducing the prevalence of mother-to-child transmission (MTCT) as compared to the administration of either the vaccine or HBIG in isolation (Veronese et al., 2021).

As per the guidelines outlined by the World Health Organization (WHO), the co-administration of Hepatitis B immunoglobulin (HBIG) alongside vaccination may provide additional benefits for infants born to mothers who test positive for Hepatitis B surface antigen (HBsAg), particularly if they also test positive for Hepatitis B e antigen (HBeAg). The introduction of universal passive and active immune-prophylaxis for neonates has led to a substantial decrease of 85-95% in the transmission rate of Hepatitis B Virus (HBV) (Yao et al., 2022). Hence, the World Health Organization

(WHO) and other recommendations advocate for the administration of both Hepatitis B immune globulin (HBIG) and the Hepatitis B vaccine to children delivered to HBsAg-positive moms within 12 hours after delivery. Furthermore, the complete immune-prophylaxis protocol entails the administration of a minimum of two additional doses of the Hepatitis B vaccination, with the first dose given one month after birth and the second dose given six months after birth(Yao et al., 2022).

However, the need to provide Hepatitis B immune globulin (HBIG) with vaccination in infants born to mothers who test positive for Hepatitis B surface antigen (HBsAg) but negative for Hepatitis B e antigen (HBeAg) remains undetermined. The results of a recent systematic review and meta-analysis suggest that the effectiveness of vaccination alone is similar to the combined use of HBIG and vaccine in preventing the transfer of HBV infection from HBsAg-positive and HBeAg-negative mothers to their newborns (Veronese et al., 2021). Additional data is necessary to substantiate the rationale for including Hepatitis B immune globulin (HBIG) into the immunization protocol for infants delivered to mothers who test positive for Hepatitis B surface antigen (HBsAg) but negative for Hepatitis B e antigen (HBeAg) (Roma et al., 2023).

Based on the prevailing standards established by the World Health Organization (WHO), the addition of hepatitis B immunoglobulin (HBIG) may not significantly augment the efficacy of fast vaccination in preventing the transfer of hepatitis B virus (HBV) from mother to child (MTCT). This pertains primarily to neonates delivered at full term to mothers who test positive for hepatitis B surface antigen (HBsAg) but negative for hepatitis B e antigen (HBeAg). Liu et al., (2019) state that the unresolved issue pertains to the administration of monthly hepatitis B immune globulin (HBIG) during the third trimester of pregnancy to asymptomatic pregnant women who test

positive for hepatitis B surface antigen (HBsAg), and its impact on preventing the transmission of hepatitis B virus (HBV) from mother to child (MTCT). Supporters of this viewpoint argue that the giving of many incremental intramuscular injections of HBIG has the potential to provide passive immunization by directly neutralizing maternal HBV (Wang, 2017).

The academic community continues to discuss the most effective strategy for reducing the incidence of mother-to-child transmission (MTCT) of the hepatitis B virus (HBV). In the past, there was a prevailing belief that the risk of mother-to-child transmission (MTCT) of hepatitis B virus (HBV) was increased after vaginal delivery due to the direct contact between the infant's mucosal membrane and maternal fluids or blood (Yao et al., 2022). The theory presented above demonstrates that the use of caesarean delivery is associated with a decreased risk of mother-to-child transmission (MTCT) of hepatitis B virus (HBV). On the contrary, independent study results have shown that there is no noticeable discrepancy in the incidence of mother-to-child transmission (MTCT) when comparing caesarean birth with vaginal delivery (Zhang et al., 2012).

Currently, the identification of Hepatitis B surface antigen (HBsAg), Hepatitis B e antigen (HBeAg), and Hepatitis B viral DNA (HBV DNA) has been confirmed in breast milk. Multiple studies have provided evidence indicating that nursing by women who test positive for the Hepatitis B surface antigen (HBsAg) does not result in an elevated risk of mother-to-child transmission (MTCT) of Hepatitis B virus (HBV) infection. The aforementioned conclusion is substantiated by a study done by Martyn et al. (2022), indicating that the act of nursing by moms who test positive for HBsAg does not lead to a greater prevalence of HBV infection in newborns in comparison to those who are nourished with formula.

2.1.9 Seroprevalence of Hepatitis B among pregnant women

The global prevalence of hepatitis B virus (HBV) infection is a significant public health issue, with pregnant women being particularly vulnerable due to the potential vertical transmission of the virus from mother to child during the process of birthing (McMahon et al., 2021). A comprehensive examination and statistical analysis of 88 research carried out in 29 countries revealed that the worldwide prevalence of hepatitis B surface antigen (HBsAg) among pregnant women was 2.98% (95% CI: 2.63-3.32), indicating a moderate degree of endemicity (Bancha et al., 2020). The regions with the greatest seroprevalence rates were identified as the Western Pacific area, with a rate of 6.35% (95% CI: 5.28-7.42), and the African region, with a rate of 3.96% (95% CI: 3.29-4.63). The study further indicated that the occurrence of hepatitis B e antigen (HBeAg) among pregnant women who tested positive for HBsAg was found to be 38.03%, indicating a substantial likelihood of transmission from mother to child (Bancha et al., 2020).

In Nigeria, a country with one of the highest rates of hepatitis B virus (HBV) infections globally, understanding the prevalence and awareness of HBV among specific populations such as pregnant women is crucial for effective public health interventions. A detailed study led by Musa, (2015) provided significant insights into the seroprevalence of Hepatitis B surface antigen (HBsAg) among this group, revealing a prevalence rate of 10.2%. This statistic is particularly concerning given the potential for mother-to-child transmission (MTCT) of HBV, which can occur during childbirth and is one of the primary modes of HBV transmission in high-prevalence regions.

The study highlighted that the highest prevalence of HBV was found in the age group of 25-34 years, where it reached 14.4% (Musa, 2015). This age group typically

encompasses a large segment of the pregnant population, indicating a significant risk not only to the infected mothers but also to their newborns, unless appropriate interventions are made. The reasons behind the higher prevalence in this age group could be multifactorial, including biological, social, and possibly a lack of targeted vaccination and education programs for this age segment.

One of the most striking findings from the Musa et al. (2015) study was that only 9.6% of the women who tested positive for HBsAg were aware of their infection status. This low level of awareness is a major barrier to controlling the spread of HBV, as unaware individuals are not only unable to seek treatment but may also inadvertently spread the virus to others, including their unborn children. The lack of awareness among these women could stem from limited access to healthcare services, lack of routine HBV screening in prenatal care programs, or a general lack of knowledge about the disease and its consequences (Musa, 2015).

Furthermore, the majority of HBsAg-positive pregnant women had not received any antiviral treatment or immunization. This treatment gap is particularly problematic given that effective interventions are available that can significantly reduce the risk of MTCT of HBV. Antiviral treatments such as tenofovir, administered during the third trimester of pregnancy, have been shown to reduce the viral load in HBV-infected mothers and, consequently, the risk of transmission to the newborn (Naseeb et al., 2023). Additionally, the administration of HBV immunoglobulin and vaccination to the newborn within 12 hours of birth is highly effective in preventing the establishment of chronic HBV infection in the infant.

The implications of these findings are profound for public health in Nigeria and similar contexts. First, there is a clear need to enhance prenatal screening programs to ensure all

pregnant women are tested for HBV. Early identification of HBV in pregnant women allows for appropriate interventions that can prevent MTCT and manage the health of the mother (Musa, 2015).

Second, increasing awareness about HBV among women of childbearing age, particularly in regions with high prevalence rates, is essential. Education campaigns that inform women about the modes of HBV transmission, the importance of screening and the availability of treatment and vaccination can empower women to seek and adhere to HBV management strategies (Nnaemeka et al., 2020) Third, integrating HBV vaccination into routine immunization schedules for all newborns, and not just those born to HBsAg-positive mothers, could further reduce the disease burden. This approach would help in creating herd immunity and decrease the overall prevalence of HBV over time (Black et al., 2023).

Further research is needed to understand the barriers to HBV screening and treatment in pregnant women, including socio-economic, cultural, and systemic factors. Studies focusing on the efficacy of various intervention strategies in different settings would also be beneficial to tailor approaches according to local needs and capabilities (Black et al., 2023). From a policy perspective, governments and health organizations should consider making HBV screening a mandatory part of prenatal care. Policy frameworks should also support the availability and affordability of antiviral treatments and vaccinations, ensuring these critical interventions are accessible to all pregnant women.

The findings from the study by Musa et al. (2015) underscore a significant public health issue in Nigeria the high prevalence of HBV among pregnant women, coupled with low awareness and treatment rates. Addressing these challenges requires a multifaceted approach involving enhanced screening, increased public awareness, and broader access

to treatment and vaccination. By focusing on these areas, health authorities in Nigeria and similar environments can make substantial progress in controlling and eventually eliminating HBV as a major public health threat.

The afore-mentioned findings indicate that hepatitis B poses a substantial public health issue for pregnant women on a worldwide scale, particularly in Africa. Consequently, there exists a necessity for enhanced screening, heightened awareness, and more effective preventative initiatives in order to mitigate the risk of vertical transmission and enhance the overall health outcomes for both mothers and children. A study done in Nigeria by Mustapha et al (2020) revealed that the prevalence of HBsAg among pregnant women in Gamawa was determined to be 6.7%, a significantly lower figure compared to the national prevalence of 14.1% among attendees of antenatal care (ANC) services. According to Mustapha et al. (2020), individuals who are female and aged 35 years or older exhibited the highest prevalence rate of 10% for HBV infection. Furthermore, the study indicated that none of the documented related variables examined were found to be significantly connected with HBV infection.

The transfer of this virus from mother to kid by vertical transmission is one of the often-seen ways of transmission. The transmission of the virus is of particular importance in pregnant women who test positive for HBeAg, since this serves as an indicator of active replication and, hence, infectivity. The three potential periods of contact for transmission from an infected mother to her kid are during pregnancy, at the moment of birth, and postnatally when nursing (Dagnew et al., 2020). Hepatitis B virus (HBV) infection is associated with difficulties that might affect both the mother and the child. The aforementioned conditions encompass coagulation disorders, exacerbation of Postpartum Haemorrhage, Renal failure, stillbirths, Neonatal mortality, Cirrhosis, and Liver Cancer.

An achievement in the battle against this virus has been the development of a very effective vaccination targeting it. Therefore, prioritising universal screening during prenatal visits and implementing vaccines are crucial for early management and prevention of this very lethal virus. The screening of pregnant women for Hepatitis B surface antigen (HBsAg) can provide an accurate estimation of the disease's prevalence within a given community (Veronese et al., 2021). According to global data, the annual mortality rate attributable to the deleterious impacts of the hepatitis B virus amounts to around 780,000 individuals. Approximately 8 to 8.2% of pregnant women in Ethiopia are estimated to be afflicted with this virus, rendering the nation one of the regions significantly impacted by its prevalence (Asgedom et al., 2024).

2.1.10 Level of awareness of Hepatitis B among pregnant women

Global studies assessing hepatitis awareness among pregnant women have shown varying levels of knowledge and awareness. Some studies indicate a lack of awareness about hepatitis transmission routes, prevention measures, and the importance of screening during pregnancy (Sanchez et al., 2018). Other studies have reported higher levels of awareness among pregnant women, particularly in regions with established hepatitis prevention programs and healthcare infrastructure.

Studies conducted in sub-Saharan Africa have highlighted significant gaps in hepatitis awareness among pregnant women, particularly in rural and underserved communities (Larebo et al., 2024). Factors contributing to low awareness in sub-Saharan Africa include limited access to healthcare services, low health literacy, and cultural beliefs and stigma surrounding hepatitis (Larebo et al., 2020). Intervention studies aimed at improving hepatitis awareness among pregnant women have shown promising results in both global and sub-Saharan African settings. Educational interventions, community

outreach programs, and integration of hepatitis screening into antenatal care services have been effective in raising awareness and promoting preventive behaviors among pregnant women Barriers to hepatitis awareness among pregnant women in both global and sub-Saharan African contexts include lack of knowledge among healthcare providers, limited access to screening and vaccination services, and cultural misconceptions about the disease (Sanchez et al., 2018; Larebo et al., 2024).

Hepatitis B (HBV) remains a significant public health challenge globally, with particular concerns in regions like Africa where the prevalence is high and awareness is low, especially among vulnerable populations such as pregnant women. The World Health Organization (WHO) aims to eliminate viral hepatitis as a public health threat by 2030, a goal that includes increasing awareness and improving vaccination coverage. Understanding the level of awareness among pregnant women is crucial, as they represent a key demographic for preventing mother-to-child transmission (MTCT) of the virus (Huang et al., 2023).

Globally, the level of awareness about hepatitis B varies significantly among different populations, influenced by several factors including educational attainment, access to healthcare services, and the reach and effectiveness of public health campaigns. The WHO has been actively promoting the importance of comprehensive strategies to tackle hepatitis B, especially in high-prevalence areas. These strategies include widespread immunization, routine screenings, particularly for pregnant women, and education campaigns aimed at improving understanding of the disease and its transmission pathways (Huang et al., 2023).

In Africa, the situation is particularly dire due to a combination of limited healthcare infrastructure, inadequate public health campaigns, and generally lower levels of

education. A study by Eke et al. (2020) highlighted that only 36.6% of pregnant women in sub-Saharan Africa had adequate knowledge of hepatitis B. This lack of awareness is a major concern because it directly impacts the willingness and ability of expectant mothers to seek HBV screening and adhere to preventive measures, such as receiving the HBV vaccine or ensuring that their newborns are vaccinated immediately after birth.

Several key factors contribute to the low level of hepatitis B awareness among pregnant women in Africa. Many regions in Africa suffer from inadequate healthcare infrastructure, which limits access to routine medical care and information. Pregnant women in rural or underserved urban areas often do not have regular contact with healthcare providers who can screen for HBV and provide necessary counseling and vaccinations (Miyakawa et al., 2021). Additionally, lower levels of education correlate with reduced health- related knowledge, including understanding of how HBV is transmitted and its potential consequences. Educational programs specifically targeting hepatitis B are crucial for raising awareness and changing behavior.

Effective public health campaigns are essential for educating the public about hepatitis B. In many African countries, these campaigns are not sufficiently funded or prioritized, leading to a lack of widespread knowledge and awareness. In some cultures, there is stigma associated with infectious diseases, including HBV, which can deter individuals from seeking information or treatment. Cultural beliefs may also lead to misconceptions about the virus and its transmission, further hindering effective prevention and treatment efforts (Mozalevskis et al., 2018).

To combat the low levels of awareness, targeted educational programs and public health campaigns need to be implemented. These should be designed to reach a broad audience and tailored to address local cultural contexts and languages (Mugabiirwe et al., 2022).

Key components of these campaigns should include clear, accessible information about how HBV is transmitted, emphasizing that the virus can be passed from mother to child during childbirth, and education on the benefits of early screening during pregnancy and the effectiveness of the HBV vaccine in preventing MTCT. Involving community leaders and influencers in education efforts can help overcome cultural barriers and increase the reach of health messages (Ghazzawi et al., 2022). Incorporating HBV education and vaccination into existing maternal and child health programs can ensure that pregnant women receive the information and services they need.

Strategic public health approaches are required to increase the level of hepatitis B awareness among pregnant women in Africa. These approaches should include enhancing healthcare infrastructure, improving access to healthcare facilities, and ensuring that these are equipped to handle HBV screening, vaccination, and education (Ghazzawi et al., 2022). Collaborations between governments, non-governmental organizations (NGOs), and international health bodies like the WHO to fund and promote hepatitis B awareness campaigns are also crucial. Establishing systems to monitor the effectiveness of awareness programs and making adjustments based on feedback and outcomes, along with allocating sufficient resources to public health initiatives focused on hepatitis B, will ensure sustainable and long-term impact (Mugabiirwe et al., 2022).

While global efforts are underway to eliminate hepatitis B as a public health threat by 2030, significant challenges remain, particularly in regions like Africa where awareness among pregnant women is critically low. By addressing the factors that contribute to this lack of awareness through improved education, healthcare access, and targeted public health campaigns, it is possible to make substantial progress towards the WHO's elimination goals (Eke et al, 2021). The success of these efforts will depend heavily on

the cooperation between governments, healthcare providers, communities, and international organizations, all working together to secure a healthier future for the next generation. It is important to raise awareness of hepatitis B among pregnant women because they can transmit the virus to their babies during childbirth, leading to chronic infection and serious health issues later in life. To reduce the risk of transmission, WHO recommends that all infants receive the hepatitis B vaccine within 24 hours of birth, followed by two or three additional doses during the first six months of life (Eke et al, 2021).

Research conducted in Ethiopia including a sample size of 354 individuals revealed that 73.4% of the participants exhibited a lack of sufficient knowledge on the subject matter. A only 18.9% of the participants possess knowledge regarding the transmission of HBV from mother to kid during the course of pregnancy. A minority of participants (43.8%) hold the belief that they are unlikely to get HBV, but a significant proportion (47.7%) seek the assistance of traditional healers upon experiencing symptoms associated with HBV. The study conducted by Teklay et al. (2020) revealed that a significant proportion of the participants, specifically 85.87%, had not undergone screening for Hepatitis B Virus (HBV). Furthermore, the findings indicated that only 28.5% of the respondents held the belief that HBV can lead to the development of liver cancer.

2.1.11 Risk factors of Hepatitis B infection among pregnant women

On a global scale, there are many risk factors associated with hepatitis B in pregnant women. The geographic distribution of hepatitis B exhibits regional variations in its prevalence, with regions such as sub-Saharan Africa, East Asia, and the Pacific Islands experiencing high occurrences. The age of pregnant women significantly influences the

likelihood of acquiring acute hepatitis B infection, with younger women showing higher susceptibility, whereas older women are more prone to becoming chronic carriers of the virus (Mamuye et al., 2020). Certain professional groups, such as healthcare workers and individuals engaged in sex work, exhibit heightened susceptibility due to the nature of their work. Engaging in multiple sexual partnerships or having a history of sexually transmitted infections (STIs) elevates the risk of contracting hepatitis B (Tesfu et al., 2023).

Intravenous drug use and sharing needles or drug equipment are other notable transmission routes. Additionally, cohabitation with an infected individual or traveling to high-prevalence regions increases the likelihood of infection (Veronese et al., 2021). Hepatitis B remains a significant health challenge in Sub-Saharan Africa, where its prevalence impacts vulnerable populations, including pregnant women, who face an elevated risk of mother-to-child transmission (MTCT) (Tesfu et al., 2023). The WHO notes that MTCT during childbirth can occur if maternal infections are not managed appropriately (Veronese et al., 2021).

Contributing factors in Africa include insufficient healthcare infrastructure, limited access to vaccination, and cultural practices such as scarification and female genital mutilation (FGM), which often involve non-sterile instruments (Mamuye et al., 2020). Addressing these requires culturally sensitive public health interventions involving community leaders to change perceptions and behaviors (Chinenye et al., 2015). A study in Nigeria revealed that pregnant women testing positive for HBsAg often exhibited chronic infection and faced higher risks of transmission to their newborns, emphasizing the need for early screening and treatment (Chinenye et al., 2015).

Research in Ethiopia highlighted that 3.04% of pregnant women tested positive for HBsAg, with risk factors including tattoos, multiple sexual partners, and sharing sharp objects (Tesfu et al., 2023). Another study found a 6.1% prevalence of HBsAg among pregnant women in the Oromo region, linked to unsafe medical practices and a history of abortion (Mamuye et al., 2020). Effective interventions, such as expanding healthcare infrastructure, increasing vaccination coverage, and enhancing education programs, are critical for addressing these issues (Singh et al., 2014). Furthermore, maternal viremia and elevated HBV DNA levels are significant factors for MTCT, highlighting the need for preventive strategies during pregnancy (Veronese et al., 2021).

2.1.12 Barriers and challenges to hepatitis prevention among pregnant women

Barriers and challenges to hepatitis prevention among pregnant women exist both globally and within the African context. Globally, many pregnant women lack awareness and knowledge about hepatitis B transmission, prevention measures, and the importance of screening and vaccination during pregnancy (Chan et al., 2023).

In African countries, low health literacy, cultural beliefs, and stigma surrounding hepatitis contribute to limited awareness among pregnant women (Dahabreh et al., 2021). Access to healthcare services, including antenatal care, screening, and vaccination programs, is often limited, particularly in low-resource settings (Omondi et al., 2022). In Africa, challenges such as long distances to healthcare facilities, transportation costs, and inadequate infrastructure hinder pregnant women's access to hepatitis prevention services. The cost of hepatitis screening and vaccination may be prohibitive, particularly in countries where healthcare services are inadequately subsidized or not covered by insurance (Akinyi et al., 2023).

Out-of-pocket payments for healthcare in African countries can create significant barriers, especially for women from low-income households (Ahmed et al., 2022). Stigma and discrimination associated with hepatitis often deter pregnant women from seeking testing and treatment services due to fear of social rejection or negative attitudes from healthcare providers (Mugambi et al., 2021). Cultural and religious beliefs may also influence attitudes toward hepatitis prevention, leading to reluctance to engage with healthcare services or adhere to recommended interventions (Nyaga et al., 2024). Weak health systems, inadequate infrastructure, and shortages of trained healthcare providers pose additional challenges to delivering comprehensive hepatitis prevention services (Njenga et al., 2020).

Addressing these barriers requires a multi-faceted approach, including improving health literacy, expanding access to healthcare services, reducing costs, combating stigma, and integrating hepatitis prevention into existing maternal and child health programs (Omondi et al., 2022). Many pregnant women may remain unaware of their hepatitis B status or the associated risks, leading to missed opportunities for prevention and timely interventions (Ott et al., 2022). Inadequate access to prenatal care can hinder early detection and management of hepatitis B in pregnant women. Regular prenatal visits are essential for screening, vaccinating, and providing antiviral therapy when necessary (Akinyi et al., 2023).

Stigma and discrimination can discourage pregnant women from seeking appropriate care or disclosing their infection status (Mugambi et al., 2021). Fear of discrimination or social exclusion further discourages healthcare access. Cultural beliefs and language barriers pose challenges to delivering effective prevention strategies, requiring tailored health education materials, counseling sessions, and communication that reflect cultural contexts and languages (Mozalevskis et al., 2020).

The cost of hepatitis B screening, vaccination, and treatment remains a significant barrier for pregnant women, particularly in low-income settings (Ahmed et al., 2022). Health systems in some regions lack infrastructure, resources, and trained healthcare providers necessary for delivering comprehensive hepatitis prevention services (Njenga et al., 2020). Despite preventive measures, vertical transmission persists due to challenges in achieving universal immunization coverage, ensuring timely post-exposure prophylaxis for newborns, and promoting breastfeeding practices that minimize transmission (Ott et al., 2022).

2.13 Effectiveness of Hepatitis B vaccine in mother to child transmission

The effectiveness of the hepatitis B vaccine in preventing mother-to-child transmission (MTCT) of the virus has been well-documented globally and in the context of sub-Saharan Africa. Globally, the hepatitis B vaccine has been shown to be highly effective

in preventing MTCT of the virus when administered to newborn infants according to recommended schedules (Schillie et al., 2018).

Studies have demonstrated that timely vaccination of newborns with the hepatitis B vaccine, along with administration of hepatitis B immune globulin (HBIG) for infants born to HBV-positive mothers, can significantly reduce the risk of vertical transmission (Schillie et al., 2018). In sub-Saharan Africa, where hepatitis B infection is endemic and MTCT is a significant route of transmission, the hepatitis B vaccine plays a crucial role in preventing perinatal transmission (Humphrey et al., 2019).

Hepatitis B virus (HBV) infection remains a significant public health challenge, particularly in sub-Saharan Africa where the prevalence rates are among the highest in the world. Recent studies by researchers such as Humphrey et al. (2019) and Lemoine et al. (2017) have documented the positive effects of implementing vaccination programs

aimed at pregnant women and newborn infants. These programs have significantly reduced the incidence of HBV among children in these regions. The success of these initiatives highlights the effectiveness of early intervention in preventing the establishment of chronic HBV infections, which are more difficult to treat and manage later in life.

Despite the success of vaccination programs, numerous challenges persist in achieving universal access to preventive measures, particularly in resource-limited settings. One primary issue is logistical challenges, including inadequate transportation infrastructure that complicates vaccine delivery and limited cold chain facilities necessary for storing vaccines at required temperatures (Omondi et al., 2023). These logistical issues are compounded by the economic constraints faced by many African nations. Resource-limited settings often struggle with the financial requirements to sustain widespread vaccination programs, including costs associated with training healthcare workers and maintaining vaccine supply chains (Ahmed et al., 2021).

Cultural and social barriers in some communities further exacerbate these challenges, leading to vaccine hesitancy or refusal. Misinformation and cultural beliefs about vaccines necessitate targeted educational campaigns that are both informative and respectful of local traditions (Nyaga et al., 2024). Limitations within healthcare systems, such as shortages of trained healthcare workers and inadequate facilities, are particularly problematic in rural or conflict-affected areas where access to healthcare is severely constrained (Njenga et al., 2020).

To overcome these challenges and improve access to vaccination services, a comprehensive approach is required. Strengthening healthcare infrastructure is crucial and involves improving transportation systems for vaccine delivery, expanding cold

chain capabilities, and increasing the number and capacity of healthcare facilities in underserved areas (Akinyi et al., 2023). Financial support from both domestic sources and international donors is also essential to cover the costs of vaccines and infrastructure improvements necessary for effective vaccination programs (Ahmed et al., 2021).

Engaging with communities through education and outreach programs is critical to addressing vaccine hesitancy and misinformation. These programs should be culturally sensitive and involve local leaders and influencers to enhance their effectiveness (Mugambi et al., 2021). Incorporating hepatitis B vaccination into existing maternal and child health services can improve efficiency and coverage, ensuring vaccinations are part of routine care during pregnancy and after childbirth (Omondi et al., 2023). Regular monitoring and evaluation are vital to assessing the effectiveness of vaccination programs and identifying areas needing improvement. This data is crucial for fine-tuning strategies and demonstrating the impact of vaccination on reducing the incidence of hepatitis B (Ott et al., 2022).

While significant strides have been made in reducing hepatitis B incidence among children in sub-Saharan Africa through vaccination programs, the journey towards universal access and high coverage rates remains challenging. Addressing these issues requires a multifaceted strategy, including strengthening infrastructure, increasing funding, engaging communities, integrating services, and conducting ongoing monitoring and evaluation. By tackling these challenges, substantial progress can be made toward controlling and eventually eliminating hepatitis B as a public health threat in the region.

Barriers to vaccination in sub-Saharan Africa include limited healthcare infrastructure, vaccine supply chain issues, and competing health priorities (Humphrey et al., 2019; Lemoine et al., 2017). Integration of hepatitis B vaccination into routine maternal and child health programs, including antenatal care and immunization services, is essential for maximizing vaccine coverage and preventing MTCT of HBV (Humphrey et al., 2019). Studies have emphasized the importance of promoting awareness about the benefits of hepatitis B vaccination among pregnant women and healthcare providers to ensure uptake of vaccination services (Humphrey et al., 2019; Lemoine et al., 2017).

The effectiveness of the hepatitis B vaccine in avoiding the transfer of the hepatitis B virus (HBV) from mother to child has been extensively demonstrated, especially when used as part of a comprehensive preventive strategy. The conventional method typically entails administering the hepatitis B vaccine together with hepatitis B immunoglobulin (HBIG) to the newborn within a period of 12-24 hours postpartum, followed by strict adherence to the recommended immunization schedule (Pattyn et al., 2021). Numerous researches have provided empirical data that substantiates the effectiveness of this approach in reducing the likelihood of vertical transmission of hepatitis B virus (HBV) from mother to child. Makokha et al. (2023) conducted a research whereby a meta-analysis was undertaken to analyse the data derived from 38 trials. The findings of the study revealed that the utilisation of both the hepatitis B vaccination and HBIG demonstrated a 92% efficacy in preventing the transmission of hepatitis B virus (HBV) from mother to child (MTCT) in infants born to mothers who tested positive for hepatitis B surface antigen (HBsAg).

A distinct inquiry conducted in Taiwan investigated the consequences of a comprehensive statewide implementation of a hepatitis B vaccination programme for newborns, which was initiated in 1984. The study conducted by Ni et al. (2014) shown

a significant drop in the prevalence of chronic HBV infection in persons aged 6-19 years. The data indicated a fall from 9.8% before to the implementation of the programme to 0.7% in the year 2014.

The effectiveness of the hepatitis B immunisation in avoiding the vertical transfer of the hepatitis B virus from mother to child is significant. According to the World Health Organisation (2021), the hepatitis B vaccine has a protection rate over 90% for infants born to HBsAg-positive mothers, given that it is administered with precision. The effectiveness of the vaccine is increased when it is given along with hepatitis B immune globulin (HBIG) during the first 12 hours after birth, and then followed by strict adherence to the recommended immunization schedule.

Safadi et al. (2021) conducted a study that shown a 92% effectiveness of the hepatitis B immunisation in preventing mother-to-child transmission. The study evaluated the effectiveness of the vaccination in infants born to mothers who tested positive for HBsAg, received timely birth dose immunisation, and completed the full three-dose regimen.

A study was conducted to evaluate the efficacy of the hepatitis B vaccine as an independent intervention in the prevention of perinatal transmission of hepatitis B in infants delivered to women who are carriers but tested negative for hepatitis B e antigen. The research included a cohort of 620 neonates who were delivered to mothers identified as carriers of HBeAg-negative status and were later enrolled in the study. Group 1 contained a total of 195 newborns who had received the hepatitis B virus (HBV) vaccination solely after birth (Zhang et al., 2022). In contrast, Group 2 consisted of 425 children who had received both the HBV immune globulin (HBIG) and the HBV

vaccine. The research included the longitudinal monitoring of people from early infancy until they reached the ages of 68 and 42 months, correspondingly.

The transfer of hepatitis B virus (HBV) from mother to child, also known as mother-to-child transmission (MTCT), was seen in none of the instances in Group 1 (0%, 0 out of 195 cases) when just the HBV vaccination was provided. Similarly, in Group 2, where both the HBV vaccine and hepatitis B immune globulin (HBIG) were administered, MTCT of HBV was also not observed in any of the cases (0%, 0 out of 425 cases). As stated by Zhang et al. (2022), the incidence of mother- to-child transmission (MTCT) of HBV is prevalent in the absence of preventative interventions. In the absence of vaccination, it has been reported that a range of around 20% to 40% of babies born to women who are carriers of HB surface antigen (HBsAg) acquire infection by the age of one, with notable variability. Infants born to women who test positive for HB e antigen (HBeAg) have a notably elevated risk of infection, with rates ranging from 70% to 90% (Zhang et al., 2022).

The observed percentages are subject to the effect of many maternal risk factors. Jourdain et al. (2019) have shown that a significant majority, namely over 90%, of neonates who get a hepatitis B virus (HBV) infection either during the birthing process or in the early stages of infancy, thereafter develop chronic carrier status for the HBV surface antigen (HBsAg). Contrarily, a notable proportion of children, around 25-30%, who get the hepatitis B virus (HBV) during the later stages of their development, namely between the ages of 1 and 5, experience the persistence of the infection, leading to a chronic state.

In order to adequately confront the public health issue presented by hepatitis B virus (HBV) infection, it is crucial to attain a substantial reduction in the occurrence of

hepatitis B surface antigen (HBsAg) in children aged 5 years and less, with the objective of reaching a prevalence rate below 0.1%. The stated goal can be achieved through the implementation of universal immunisation of newborns against hepatitis B and the utilisation of diverse strategies to hinder the transmission of HBV from mother to child (Jourdain et al., 2019). These strategies include the administration of antiviral prophylaxis during the peripartum period in pregnant women who test positive for HBsAg. The World Health Organisation (WHO, 2021) has identified mother-to-child transmission (MTCT) of the hepatitis B virus (HBV) at or soon after birth, as well as throughout early childhood, as the key factor contributing to the global incidence of chronic hepatitis B infection. There is a notable correlation between perinatal and early-childhood infections and a high incidence of chronicity.

The hepatitis B immunisation may be delivered promptly after delivery by means of a timely birth dose (TBD) of the vaccine, preferably given within 24 hours after the birth of the infant. Moreover, the implementation of regular early baby immunisation serves as an additional approach for administering the hepatitis B vaccination throughout the early stages of childhood. This intervention has a crucial role in the reduction of mother-to-child transmission (MTCT) of the hepatitis B virus (HBV) and transmission throughout early infancy (Jourdain et al., 2019).

According to the World Health Organisation (WHO) it is now advised to universally adopt vaccination for infants, including the administration of at least three doses of the hepatitis B vaccine. The hepatitis B immunisation should be provided shortly after birth, preferably within a 24-hour period. The administration of a complete series of hepatitis B immunisations in babies leads to the establishment of immunological protection, successfully mitigating the risk of infection in more than 95% of children (WHO, 2022).

The timely administration of infant hepatitis B immunoglobulin prophylaxis following delivery, when available, and the implementation of maternal peripartum prophylaxis with antiviral medications may provide additional measures to prevent the transmission of hepatitis B virus (HBV) from mother to child. Since 2020, the World Health Organisation (WHO) has provided additional recommendations regarding the administration of tenofovir prophylaxis to pregnant women who test positive for Hepatitis B Virus (HBV) infection, specifically those who are positive for HBsAg. These recommendations suggest initiating the prophylaxis at the 28th week of pregnancy and continuing it until delivery, with consideration given to specific criteria. The purpose of this supplementary directive is to mitigate the spread of the hepatitis B virus (HBV) throughout the process of pregnancy and childbirth. This directive is intended to complement the current practise of administering a three-dose hepatitis B vaccine to all infants, including those with an undetermined vaccination status (WHO, 2023).

The assessment of the effectiveness of preventive methods in reducing vertical transmission rates may be carried out by clinical trials, observational studies, or meta-analyses. The process of vertical transmission of Hepatitis B Virus (HBV) is highly efficient, with transmission rates ranging from 70% to 90% for mothers who test positive for hepatitis e antigen, and from 10% to 40% for mothers who test negative for hepatitis e antigen, in the absence of any prophylactic treatments. The occurrence of maternal viraemia poses a substantial danger for the vertical transmission of the hepatitis B virus

HBV). The first step in mitigating vertical transmission of Hepatitis B Virus (HBV) is doing maternal screening. The research conducted by Veronese et al. (2021) emphasises the potential for achieving worldwide eradication of HBV infection with the use of essential strategies, including the administration of hepatitis B passive and active

immunoprophylaxis during infancy, in conjunction with antiviral medication for women with high virus loads.

2.2 Theoretical framework

2.2.1 Social Cognitive Theory (SCT)

The social cognitive theory (SCT), which is used in psychology, education, and communication, says that some of a person's knowledge can be directly linked to what they see others do in social interactions, experiences, and media influences from the outside. Albert Bandura came up with this theory as an extension of his theory about how people learn from each other (Bandura, 1986).

The theory says that when people watch a model act in a healthy way and see what happens as a result, they remember the order of events and use this information to guide their own actions in the future. Seeing a model can also make a person do something they have already learned how to do. In other words, people do not just pick up new habits by trying them out and seeing if they work or not (Bandura, 1986).

Instead, the survival of humanity depends on people copying the actions of others. Whether or not people are rewarded or punished for their actions and how those actions turn out can affect whether or not an observer decides to copy the behavior being shown (Bandura, 1986).

People from all walks of life and in all kinds of settings can find models in the media. The social cognitive theory is a way of thinking about how people learn. It says that people learn by watching how other people act . These routines that a person picks up through time might become extremely significant components of their personality. Social psychologists agree that a person's behavior is influenced by the environment in

which they were raised. However, they also believe that the individual (and, by extension, what they know) is just as significant (Bandura, 1986).

People learn by watching what others do. The environment, how people act, and what they know are the three most important things that affect development. Each behavior a person sees can change the way they think (cognition). In a similar way, a person's upbringing can affect how they act as an adult. For example, a caregiver's way of thinking (also called cognition) affects how their children are raised (Bandura, 1986).

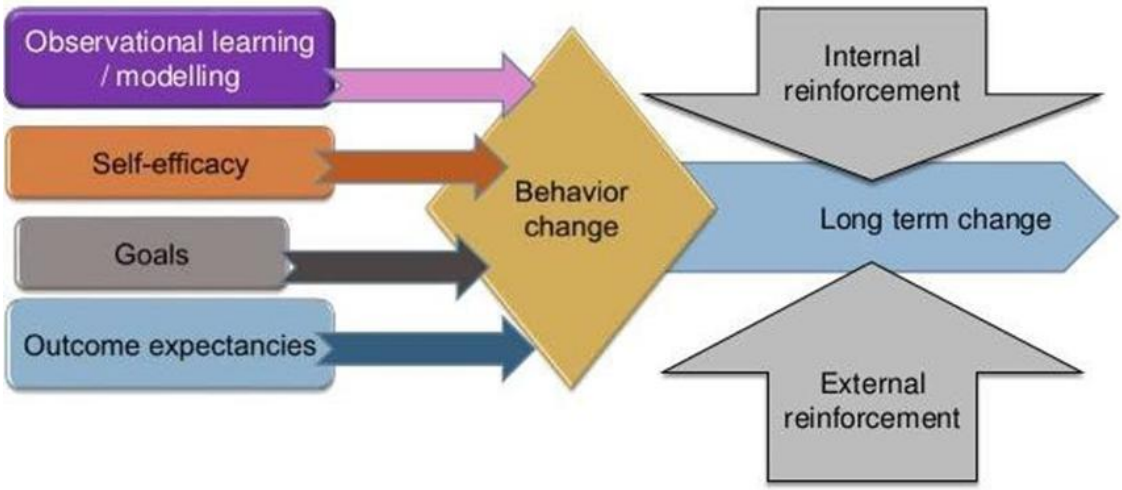


Figure 1: Social Cognitive Theory model Source: (Bandura, 1986)

Applying the social cognitive theory in the context of the research studying Seroprevalence of hepatitis B and vaccine effectiveness in vertical transmission prevention among pregnant women in Abyei, South Sudan, the researcher examined various elements such as observational learning, self-efficacy, and social influences.

Observational Learning: Researcher examined how the behaviors of others influence individuals' choices around vaccination. For example, if a pregnant woman observed that her peers or family members were being vaccinated or taking their children to be vaccinated against hepatitis B, she may be more likely to do the same. On the contrary,

if she sees that others in her community are not being vaccinated, she may also choose not to.

Self-efficacy: Self-efficacy refers to an individual's belief in their capacity to execute behaviors necessary to produce specific performance attainments. In this context, if a pregnant woman believes that she has the ability to get her infant vaccinated and that it will be effective in preventing vertical transmission of hepatitis B to her baby, she may be more likely to get her infant vaccinated.

Social Influences: Social factors such as cultural beliefs, social norms, and perceived social support could influence the decision to get vaccinated. For example, if the prevailing belief in a community is that vaccines are harmful, then pregnant women in that community may be less likely to choose vaccination for their infants.

Reinforcements: Positive reinforcements such as seeing the benefits of vaccination (like healthy babies unaffected by Hepatitis B) and negative reinforcements such as witnessing the adverse effects of non-vaccination (like babies contracting the disease) can influence decision-making about vaccination.

In this research, the use of SCT was used in interviewing mothers to understand the beliefs and attitudes of pregnant women towards hepatitis B vaccination, observation of social and cultural practices around vaccination, and interventions to increase self-efficacy and provide positive reinforcements for vaccination. The findings could then guide the development of social and behavioral interventions to increase hepatitis B vaccination rates among pregnant women and reduce the incidence of hepatitis B in South Sudan.

Observational Learning: The study explored how pregnant women's behaviors related to hepatitis B vaccination and prevention are influenced by observing the actions and

outcomes of others, such as family members, friends, or healthcare providers. Positive experiences or role models may encourage vaccine uptake and adherence to preventive measures.

Outcome Expectations: Pregnant women's expectations about the outcomes of hepatitis B vaccination and prevention efforts, including the perceived effectiveness of the vaccine in preventing vertical transmission and protecting their babies, could influence their motivation to engage in these behaviors.

Self-Efficacy: Assessing pregnant women's confidence in their ability to obtain hepatitis B vaccination to their infants, adhere to preventive measures, and overcome potential barriers or challenges could provide insights into their readiness to act to protect themselves and their babies from HBV infection.

Behavioral Capability: The study examined pregnant women's knowledge and skills related to hepatitis B vaccination and prevention, including their understanding of transmission routes, the importance of vaccination of their infants' vaccination and how to access healthcare services for vaccination and screening.

Environmental Factors: Exploring environmental factors that may facilitate or hinder pregnant women's engagement in hepatitis B vaccination and prevention, such as access to healthcare services, availability of educational materials, and support from healthcare providers and social networks, could inform strategies to promote vaccine uptake and adherence to preventive measures.

Reinforcement: Understanding the role of reinforcement, such as positive feedback from healthcare providers or social support from family members, in shaping pregnant women's behaviors related to hepatitis B vaccination and prevention could highlight opportunities to enhance motivation and sustain behavior change over time.

By applying the principles of Social Cognitive Theory in the study design and analysis, the researcher gianed insights into the cognitive, behavioral, and environmental factors that influence pregnant women's decisions and actions regarding hepatitis B vaccination and vertical transmission prevention. This understanding can inform the development of targeted interventions to promote vaccine uptake and improve maternal and child health outcomes.

2.3 Conceptual Framework

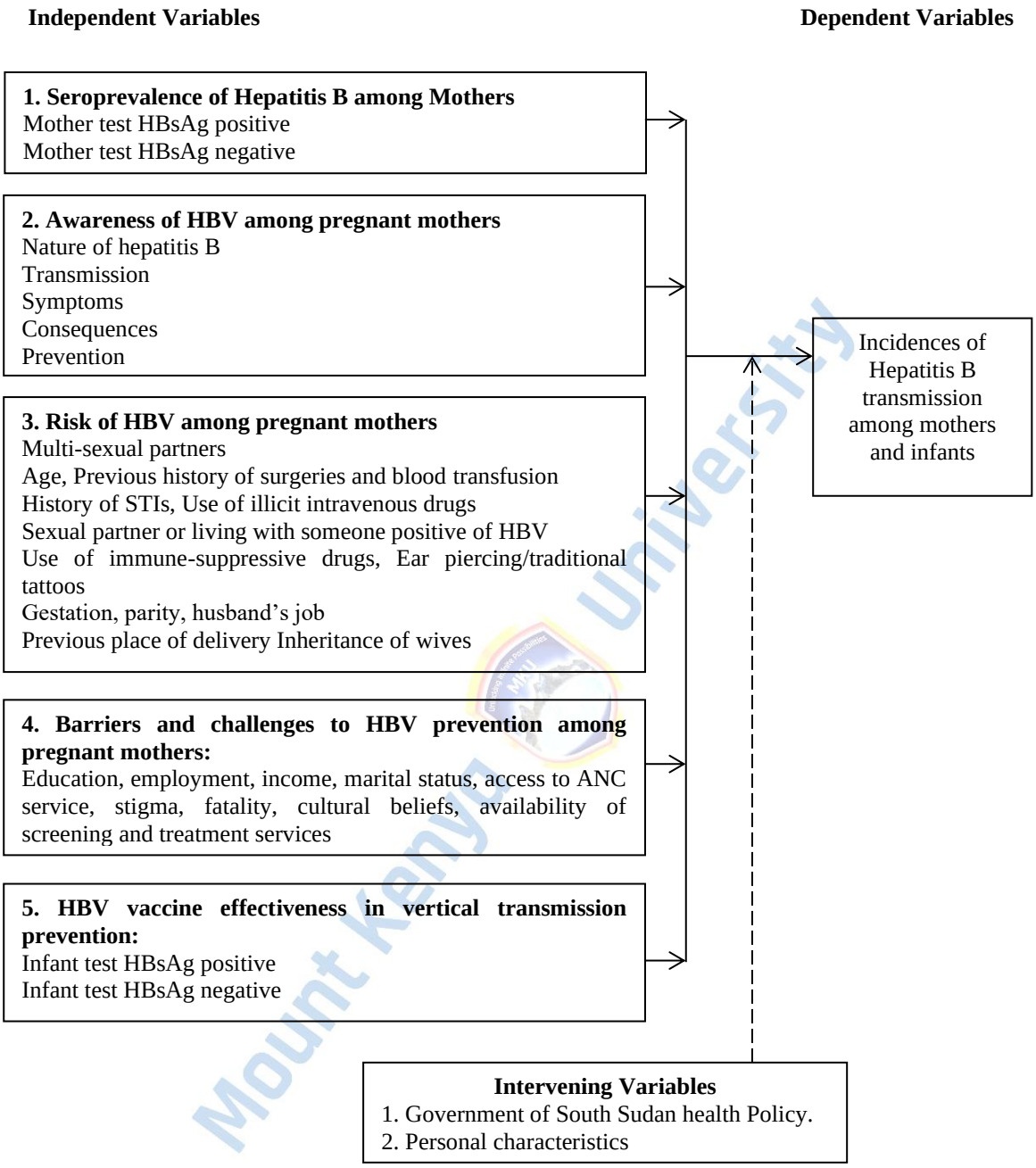


Figure 2: Conceptual framework

Awareness of HBV among pregnant mothers: This variable aims to assess the knowledge levels of pregnant mothers regarding Hepatitis B, which is essential for designing effective awareness campaigns and educational programs. The nature of hepatitis Transmission, Symptoms, Consequences and Prevention will be assessed though the use of questionnaires and the mothers' responses will be scored out of

twelve (12) questions and any pregnant mother scoring 50% will be considered aware. Scores lower that than will be considered poor lack of awareness and its relationship with the incidence of hepatitis b transmission will be tested

Risk factors of hepatitis B among pregnant mothers: The variable identifies various risk factors associated with Hepatitis B transmission among pregnant women, helping to understand the determinants of the disease in the population. Previous history of surgeries and blood transfusion, History of STIs, Use of illicit intravenous drugs, Sexual partner or living with someone positive of HBV, Use of immune-suppressive drugs, Ear piercing/traditional tattoos, Gestation, parity, husband's job, Previous place of delivery, Husband alive or dead, Inheritance of wives.. Statistical tests will be used to test their associations with the dependent variables and establish link between the two variables. Age, education, employment, income, marital status, access to ANC service, stigma, fatality, cultural beliefs, availability of screening and treatment services were assessed using both questionnaires and focus group discussion.

Barriers and challenges of hepatitis B among pregnant mothers: This variable explored the obstacles faced by pregnant women in preventing Hepatitis B, including socio-economic factors, cultural beliefs, and healthcare access issues.

Education, employment, income, marital status, access to ANC service, stigma, fatality, cultural beliefs, availability of screening and treatment services

HBV vaccine: The HBV vaccine refers to the Hepatitis B Virus vaccine, which is a highly effective immunization used to prevent hepatitis B infection. The vaccine stimulates the body's immune system to produce antibodies against the hepatitis B virus, thereby protecting individuals from infection.

Dependent variables: Incidences of Hepatitis B transmission among mothers and infants: This variable measures the occurrence of Hepatitis B transmission from mother to child, providing the primary outcome of interest for the study.

2.4 Gap analysis

The existing studies reveal significant differences in awareness levels both globally and regionally, especially in sub-Saharan Africa, where awareness is alarmingly low due to issues like inadequate healthcare infrastructure, low health literacy, and cultural stigma. While global studies show varying awareness levels influenced by access to healthcare and education, sub-Saharan Africa clearly lacks sufficient knowledge among pregnant women. This gap highlights the need for tailored educational interventions and accessible healthcare services, particularly in rural and underserved areas. Additionally, the underuse of antenatal care as a means for hepatitis B education and screening represents a missed chance to bridge this gap.

Although some intervention studies have shown encouraging results, such as incorporating hepatitis screening into antenatal services and conducting educational outreach, the scalability and long-term effectiveness of these initiatives have not been thoroughly examined. Moreover, challenges like insufficient knowledge among healthcare providers, underfunded public health campaigns, and cultural misconceptions continue to hinder awareness levels. Despite the WHO's aim to eliminate hepatitis B as a public health threat by 2030, there is a lack of evidence regarding the effectiveness of strategies specifically aimed at pregnant women in high-prevalence, low-resource environments.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter comprises the research design, study approach, study location, target population, sample size determination, sampling techniques, sampling procedures, data collection, data analysis, and ethical considerations.

3.1 Research Design

The study aimed to investigate the seroprevalence of Hepatitis B infection among pregnant women in South Sudan and evaluate the effectiveness of the Hepatitis B vaccine in preventing vertical transmission. To address this research question, a suitable study design was the hybrid type 1 implementation research design of cross-sectional study combined with a cohort study.

By combining quantitative and qualitative approaches, a hybrid type 1 implementation design provided a comprehensive understanding of implementation process and outcomes. It allowed the researcher to evaluate the effectiveness of intervention in this case, the hepatitis B vaccination, and the contextual factors that influence it. This type of study design allowed the researcher to investigate both the prevalence (seroprevalence) of an outcome or exposure at a specific point in time (cross-sectional) and the development of that outcome or exposure over a defined period (cohort).

Cross-sectional research aims to ascertain the prevalence of Hepatitis B infection among pregnant women during a given timeframe. A selection process was conducted to choose a representative sample of pregnant women from various health institutions in the Abyei area of South Sudan. The collection and analysis of blood samples involved the examination for the presence of Hepatitis B surface antigen (HBsAg). In

order to gather data on demographic features and other risk factors related to the transmission of Hepatitis B, a structured questionnaire was utilized. The calculation of the prevalence of Hepatitis B infection was conducted, yielding an approximation of the seroprevalence rate among pregnant women in South Sudan.

A cohort study was conducted among a subset of infants born of the women identified in the cross-sectional study. This cohort consisted of infants of women who are HBsAg positive. These infants were followed over time to assess the effectiveness of the Hepatitis B vaccine in preventing vertical transmission. There was a matching group of infants that calculated from the infants born of the mothers who are not positive of hepatitis B and who also received the vaccine. The infants, after vaccination, were followed up for the period of 180 days (6 months) which was incubation period of hepatitis B. The newborns were tested for HBsAg to determine if vertical transmission occurred. By comparing the incidence of vertical transmission between the newborns of HBsAg positive mothers and those newborns of negative mothers, the effectiveness of the Hepatitis B vaccine in preventing vertical transmission was evaluated.

3.2 Study Approach

The study used a mixed method approach since involved the collection of both quantitative and qualitative data among pregnant mothers seeking antenatal care in primary health clinics in Abyei Area, South Sudan. A mixed method approach tries to balance both the qualitative and quantitative data and offers a comprehensive and holistic approach to solutions to various community problems in hand, Mugenda and Mugenda, (2013).

Qualitative research methods are typically used to explore and understand complex phenomena in depth, while quantitative research methods are used to measure and

analyze data in a more structured and systematic way. By combining these two methods, researchers can gain a more holistic understanding of the research topic, as well as address potential limitations or biases that may arise from using only one method.

3.3 Study Location

Abyei, a region of geopolitical significance, lies at the heart of border disputes between the South Sudan and Sudan Governments. Positioned on the boundary between the two nations, Abyei holds strategic importance. Its geographical coordinates delineate a defined area, stretching from 11.5° N to 10.5° N latitude and 29.5° E to 27.5° E longitude. This rectangular expanse encompasses the Abyei region, flanked by Unity State to the East, Warrap State to the South, and Northern Bahr Al Ghazal State to the West. The selection of Abyei as the study location was deliberate, driven by several factors: its geopolitical significance, its status as a contested border area, and its proximity to neighboring states. These attributes render Abyei a focal point for research on issues pertaining to Hepatitis B seroprevalence and vaccine effectiveness among pregnant women attending antenatal clinics as below:

1. High Prevalence of Hepatitis B: Abyei may have a higher prevalence of hepatitis B compared to other areas in South Sudan. The prevalence of hepatitis B can vary widely between different regions due to factors such as population demographics, healthcare infrastructure, and cultural practices. Abyei's unique characteristics may make it a significant area for studying the prevalence of hepatitis B and its impact on vertical transmission

2. Limited Research: Abyei has limited existing research on hepatitis B prevalence and vaccine effectiveness, making it an area where new data and insights are needed. By

focusing on Abyei, the study can contribute to filling a gap in knowledge and understanding of hepatitis B in the region.

3. Access to Healthcare and Vaccination: Abyei's healthcare infrastructure and access to vaccination services may differ from other areas in South Sudan, which can impact the effectiveness of vertical transmission prevention measures. Understanding the specific challenges and opportunities in Abyei can provide valuable insights for improving healthcare delivery and vaccination programs.

4. Unique Population Characteristics: Abyei's population have unique characteristics, such as ethnic diversity, migration patterns, and cultural practices, which can influence the transmission of hepatitis B and the effectiveness of vaccination programs. Studying Abyei can provide insights into how these factors impact the spread of hepatitis B and the success of prevention strategies.

5. Catchment Population: The catchment population for the study would include pregnant women in Abyei and surrounding areas who seek maternal and child health services. This would encompass not only the immediate residents of Abyei but also individuals from neighboring communities who access healthcare facilities in the area. Understanding the catchment population is crucial for gauging the impact of the study and ensuring that the findings have relevance for the broader region.

This study was carried out in two selected primary health clinics in Abyei area, South Sudan. The facilities included Abyei PHCC and Ganga PHCC. Health services provision face many challenges in Abyei area as the Government and partners support a limited number of health facilities to deliver services to the population. Out of 33 facilities (primary and secondary care levels) only 19 are functional leaving a vast majority of people without services or walk a long distance to access services, with

access sometimes being made difficult by physical barriers such as poor road, mud on the road and water on the other hand and insecurity on the other. The area was selected because of its geographical proximity with the Sudan (north) and being a center for people with multiple backgrounds.

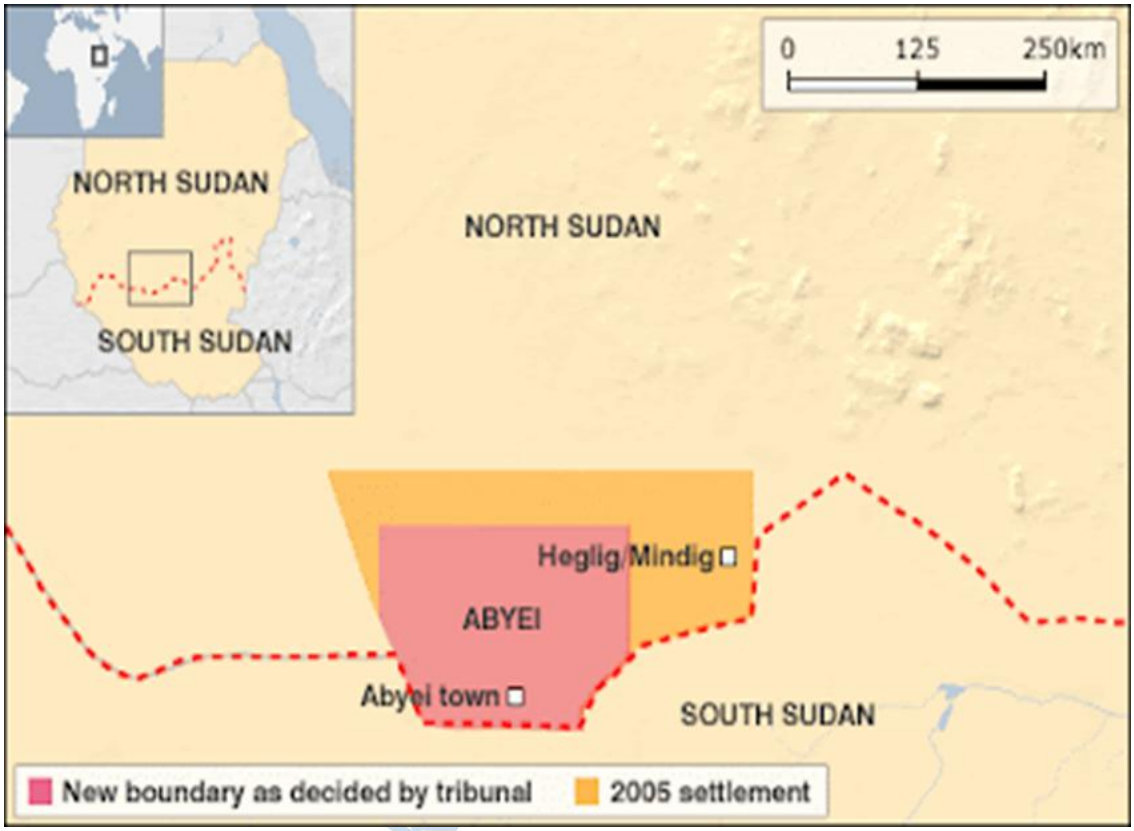


Figure 3: Map of Abyei Area, South Sudan
Source: Google Maps

3.4 Target Population

The target population for this study comprised pregnant women attending antenatal care (ANC) and their newborns in the Abyei Area, South Sudan. Specifically, the study focused on mothers residing in the southern and northern regions along the banks of River Kiir within the Abyei area. These regions include Abyei town, which is served by the Abyei Primary Health Care Center (PHCC), and Abithook, which is served by the Ganga Primary Health Care Unit (PHCU). The selection of these areas was strategic

due to their accessibility to ANC services and the ongoing healthcare efforts in the region.

Data from the Save the Children International (SCI) morbidity reports for 2020, 2021, and 2022 provided valuable insight into the attendance of pregnant women for their fourth antenatal care visits over the past three years. The figures indicated a steady attendance, with 2,295 pregnant women in 2020, 2,678 in 2021, and 3,162 in 2022, resulting in an average of approximately 2,711 pregnant women seeking ANC services annually. This consistent attendance reflects a significant engagement with maternal healthcare services in the Abyei area, though the lack of specific focus on HBV screening within the standard ANC services remains a gap.

Notably, Hepatitis B screening was not a part of the standard antenatal services package offered at the ANC clinics, which highlights a critical area for intervention. Given this gap, the study aimed to assess the prevalence of Hepatitis B among pregnant women attending ANC clinics and to evaluate the efficacy of the HBV vaccine in reducing the risk of vertical transmission to newborns. This research is vital for informing public health strategies and improving maternal and child health outcomes in the region, particularly in the context of the high HBV burden in South Sudan. By focusing on this area, the study seeks to contribute to the broader efforts to reduce HBV transmission rates, enhance preventive care, and improve vaccination coverage in this underserved population.

3.5 Sample Size Determination for cross-sectional study

In order to determine the appropriate sample size for this cross-sectional study, we first looked at the antenatal care (ANC) attendance records over the past three years in

Abyei, which showed an average of 2,711 women. Using the Fisher formula, the sample size (n) can be calculated with the following equation:

$n=Z2\cdot p\cdot(1-p)E2$

Where:

- n represents the required sample size
- Z is the Z-score corresponding to the desired confidence level, typically 1.96 for a 95% confidence level
- p is the estimated proportion of the population
- E is the desired margin of error, expressed as a proportion

For our calculation, we used the Z-score of 1.96 for a 95% confidence level. The estimated proportion (p) was assumed to be 0.5, as this provides the maximum variability and ensures a conservative estimate. Substituting these values into the Fisher formula:

$n=1.962\cdot0.5\cdot(1-0.5)0.052$

$n=3.8416\cdot0.250.0025$

$n=0.96040.0025$

$n\approx384.16$

Therefore, based on the Fisher formula and using a 95% confidence level, an estimated proportion of 0.5, and a margin of error of 0.05, the required sample size from a population of 2,711 is approximately 384

3.5.1 Sample Size Determination for cohort

After establishing prevalence in the cross-sectional study above, the sample size for cohort in this research was determined using formula for cohort sample size calculation as follows:

$$n\ (each\ group) = \frac{(p_0 q_0 + p_1 q_1)\left(z_{1-\alpha/2} + z_{1-\beta}\right)^2}{(p_1 - p_0)^2}$$

Where the following are needed to calculate the cohort sample size The value of alpha

The value of beta

Proportion of unexposed at risk of disease/outcome (p0) Proportion of exposed at risk of disease/outcome (p1) Ratio of exposed to unexposed

Conventionally, alpha (two-sided) = 0.05 (or 5%) and beta = 0.20 (or 20%).

From the cross sectional study, the sero-prevealence (P1) of hepatitis B among pregnant women in Abyei was found to be 19%, hence;

P1 = 0.19

P0 = 0.81

Z1 = 1.96 (95% CI)

Q0 = 1

Q1 = 1, therefore substituting in the above equation:

N = (1 + 0.19) (1.96-1.935+1.936)2 = 18.05/0.3844 = 47

So, the sample size for cohort was calculated to be 47 representing children of the mothers who tested negative for hepatitis B. The same number (47) children born of mothers positive of hepatitis B was used to match the cohort.

3.5.2 Inclusion Criteria

Pregnant mothers aged 18 - 49 years.

Sound in mind.

Infants born to mothers who are positive for Hepatitis B surface Antigen.

Infants born of mothers who are negative for Hepatitis B surface Antigen

Those willing to participate in the study and will provide consent.

Pregnant women attending antenatal clinics (ANC) in Abyei, South Sudan.

Pregnant women willing to participate in the study.

Pregnant women who provide informed consent for their participation.

Pregnant women who have not previously been diagnosed with chronic hepatitis B infection.

Pregnant women who are able to comprehend and respond to study questionnaires or interviews

3.5.3 Exclusion Criteria

Pregnant women vaccinated against hepatitis B in the past

Pregnant women who do not consent to participate in the study

Women who have lived in Abyei Area for less than 6 months

Infants whose mothers refused to be tested

Pregnant women who have been previously diagnosed with chronic hepatitis B infection.

Pregnant women who are unable to comprehend or respond to study questionnaires or interviews due to language barriers or cognitive impairment.

Pregnant women with medical conditions or complications that may affect their ability to participate in the study, as determined by healthcare providers.

Pregnant women residing outside the geographical area of Abyei, South Sudan.

Pregnant women who are not attending antenatal clinics in Abyei, South Sudan.

3.6 Sampling Techniques

The process of selecting health facilities for participation was purposeful, considering factors such as distance and the coverage of antenatal care (ANC) services in the area. The allocation of pregnant women to each facility was determined based on the utilization rate of ANC services in the selected facilities. Data from State Ministry of Health reports spanning the years 2020, 2021, and 2022 revealed that 65% (4,838 out of 8,135) of pregnant women attended ANC services at Abyei Primary Health Care Center (PHCC), while 35% (2,847 out of 8,135) attended Ganga Primary Health Care Unit (PHCU). These proportions of ANC attendance were used to calculate the number of women allocated to each facility from the total sample size of 384, as outlined in Table 1 below.

Table 1: Participants according to proportional antenatal attendance

S/No.	Location	% of ANC attendance	Number of mothers
1	Abyei PHCC	65%	0.65 x 384 = 250
2	Ganga PHCU	35%	0.35 x 384 = 134
Total		**100%**	**384**

Source: Abyei MOH data report 2022

3.7 Participants recruitment

Pregnant women attending antenatal care (ANC) were recruited systematically for this study based on their availability and willingness to participate. Mothers who tested

positive for hepatitis B were followed up until they delivered, forming the primary group of interest. In addition, a proportion of mothers who tested negative for hepatitis B were also followed up, and their newborns were recruited to form the control arm of the study, representing the unexposed group. Both groups received the routine hepatitis B vaccination, ensuring that both the exposed and unexposed populations were treated equally in terms of preventive care.

To create the control arm, a list of unique identifiers for the seronegative mothers was compiled. Each participant was assigned a random number, and the list was then sorted in ascending order to allocate the seronegative mothers and their newborns to the control arm. This random allocation method helped ensure that the control group was representative and unbiased.

For the qualitative component of the study, participants for the Focus Group Discussions (FGDs) were recruited from both pregnant and non-pregnant women, as well as traditional birth attendants who were attending the facilities. Participants were selected after they provided their full consent to take part in the discussions. This approach enabled the study to capture a wide range of perspectives on hepatitis B prevention, maternal health, and vaccine efficacy.

Key Informant Interviews (KIIs) were conducted with health workers, specifically midwives, nurses, and clinical officers, who are directly involved in healthcare service delivery at the facility level. These participants were approached for the study based on their relevant roles and knowledge in managing maternal health and hepatitis B prevention, providing critical insights into the healthcare system's response to the HBV epidemic and the challenges faced in its management at the community level. This diverse approach to participant recruitment ensured that the study would capture both

clinical and community-level perspectives, enhancing the overall comprehensiveness and validity of the findings.

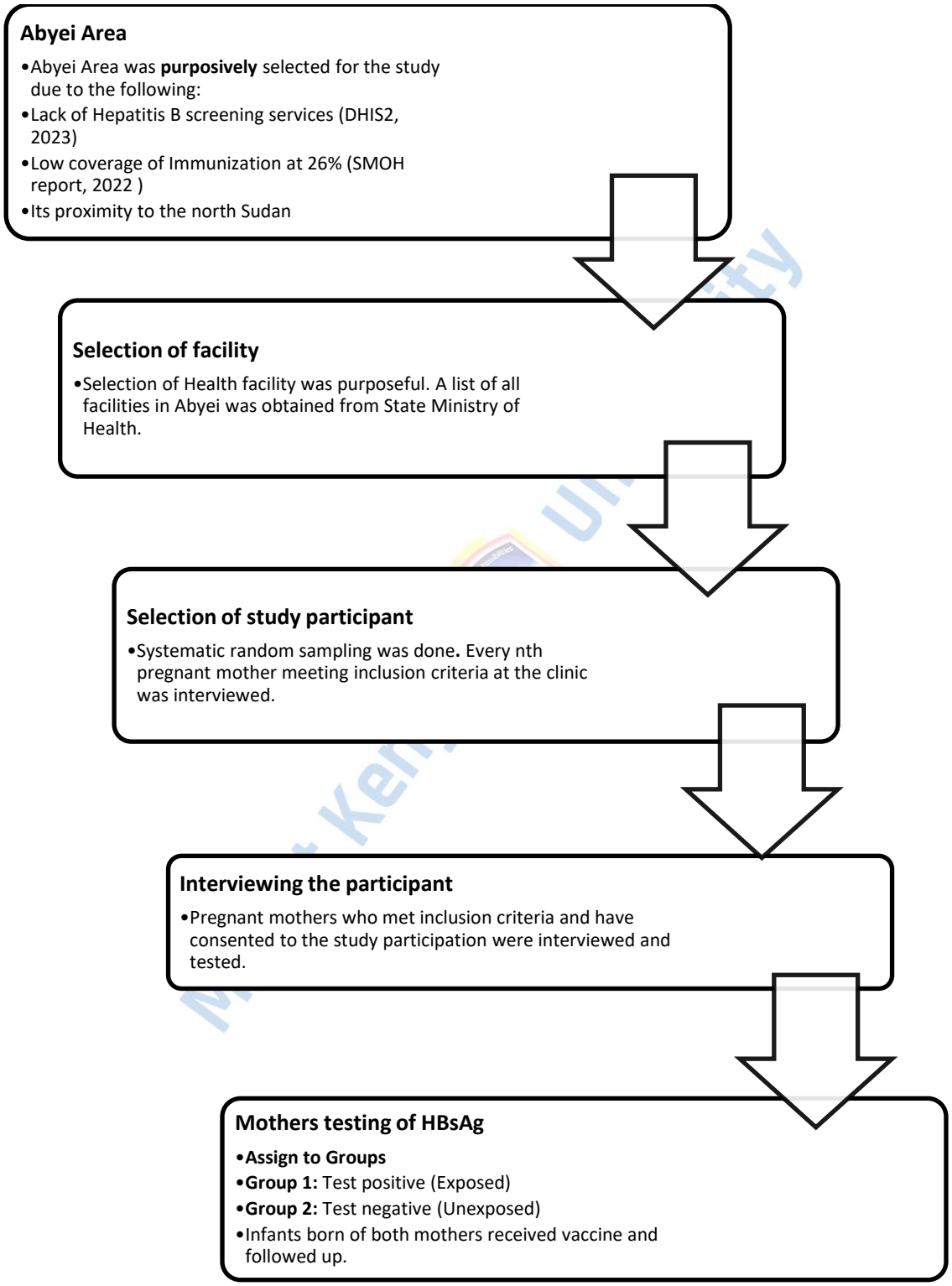


Figure 4: Sampling technique flow chart

3.7 Data Collection and Instruments

3.7.1 Questionnaire

Structured Questionnaires was used to collect quantitative data on pregnant women seeking antenatal care in the selected facilities. The questionnaires included:

Awareness of HBV among pregnant mothers: Nature of hepatitis Transmission, Symptoms, Consequences and Prevention

Risk factors of hepatitis B among pregnant mothers: Previous history of surgeries and blood transfusion, History of STIs, use of illicit intravenous drugs, Sexual partner or living with someone positive of HBV, Use of immune-suppressive drugs, Ear piercing/traditional tattoos, Gestation, parity, husband's job, Previous place of delivery, Husband alive or dead, Inheritance of wives.

Age, education, employment, income, marital status, access to ANC service, stigma, fatality, cultural beliefs, availability of screening and treatment services

Intervening factors: personal characteristics were collected through questionnaires administered to pregnant mothers and review and records in the clinics.

Qualitative data collection

The collection of quantitative data was meticulously executed through a strategic combination of Focus Group Discussions (FGD) and Key Informant Interviews (KII), both of which were aimed at comprehensively elucidating the barriers and challenges impeding the effective prevention of Hepatitis B. The FGD sessions brought together a diverse group of participants, including both pregnant and non-pregnant women, as well as traditional birth attendants (TBA), creating an environment conducive to a rich and varied exchange of perspectives. This diversity in participant backgrounds enabled

the research to capture a wide range of experiences, opinions, and insights on issues related to Hepatitis B prevention, maternal health, and vaccine access within the community.

In contrast, the KII component focused on engaging key stakeholders from the Ministry of Health, particularly those operating within the maternity department, as well as seasoned healthcare professionals such as midwives, nurses, and medical officers. These stakeholders were selected for their expertise and direct involvement in the healthcare system, particularly in maternal and child health services. Through these interactions, invaluable insights were garnered, shedding light on the multifaceted factors influencing government policies, healthcare practices, and interventions related to Hepatitis B. The discussions revealed the complexities involved in addressing HBV transmission, including logistical challenges, policy gaps, and healthcare system limitations.

The qualitative nature of the data collection process proved to be highly effective in facilitating a nuanced exploration of the intricate dynamics at play. By combining perspectives from both community members and healthcare professionals, the research was able to provide a comprehensive understanding of the challenges and opportunities inherent in Hepatitis B prevention efforts. The findings generated from these discussions and interviews contributed significantly to the identification of systemic barriers and opportunities for intervention, offering key insights for enhancing public health strategies and policies aimed at reducing the burden of Hepatitis B in the region.

3.7.1.1 Pilot Testing

Pilot testing was an essential component of the study's design and implementation, allowing for the refinement and optimization of the data collection tools before the

main data collection phase. A pilot testing phase was conducted with 38 participants, which represented approximately ten percent of the total sample size of 384. Pregnant mothers from a neighboring health facility were randomly selected to participate in this pilot phase, providing a representative sample for testing the feasibility and effectiveness of the instruments.

The primary aim of the pilot test was to evaluate the clarity, relevance, and comprehensiveness of the data collection tools, which included questionnaires and focus group discussion (FGD) guides. During this phase, the tools were tested for their ability to capture the necessary data and elicit meaningful responses from participants. Feedback was gathered from the pilot participants, as well as from the research team and facilitators, to identify any ambiguities, areas for improvement, or potential challenges in the instruments' design.

The outcomes of the pilot test were thoroughly analyzed and used to refine and modify the data collection tools. Adjustments were made to ensure that the questionnaires were clear, easy to understand, and capable of gathering accurate and relevant information. Similarly, the FGD guides were revised to ensure that the discussions would flow smoothly, fostering open communication and facilitating the exploration of key topics related to Hepatitis B prevention.

This iterative process of pilot testing and refinement significantly contributed to the accuracy and effectiveness of the data collection instruments, ensuring that they were well-suited for the subsequent main data collection phase. By addressing any issues identified during the pilot phase, the study was better positioned to gather reliable and valid data, ultimately strengthening the quality and impact of the research findings.

3.7.1.2 Data Collection Procedure

After obtaining informed written consent from each participant, data on the risk factors for hepatitis B and participants' awareness of the virus were collected using a structured questionnaire. This process was led by the principal researcher, with assistance from an experienced midwife nurse who had been trained specifically for this task by the researcher. The questionnaire covered various aspects, including demographic details, risk factors, and knowledge levels about hepatitis B, providing a comprehensive understanding of the participants' awareness and potential exposure to the virus.

In parallel, laboratory assistants collected approximately 2 mL of venous blood from each pregnant woman, which was stored in an Ethylenediamine tetraacetic acid (EDTA) tube to prevent clotting. After allowing the blood to clot, the serum was separated from the whole blood, and a rapid HBsAg test was conducted to determine if the woman was positive or negative for hepatitis B surface antigen (HBsAg). The results were delivered on the same day to ensure timely follow-up.

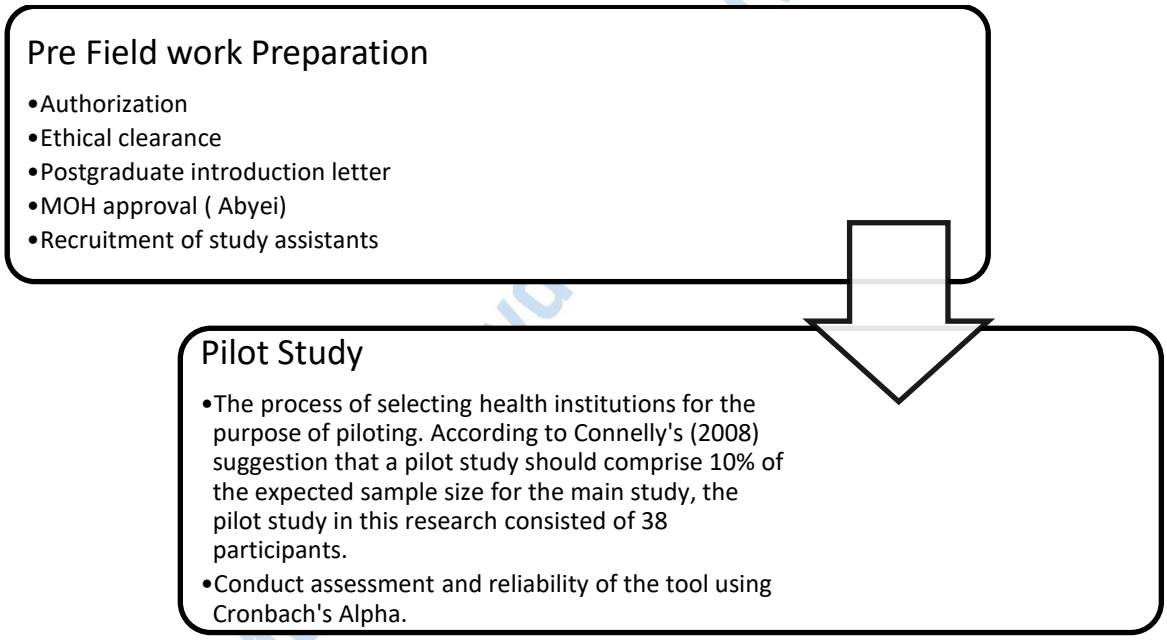
Mothers who tested positive for hepatitis B were recorded, as were those who tested negative. Both groups of mothers were followed up until they delivered their babies. After birth, all newborns received the hepatitis B birth dose vaccine, followed by subsequent doses at 6, 10, and 14 weeks, as per standard vaccination protocols. After six months, the infants were tested to assess whether the vaccine had effectively protected them from mother-to-child transmission of HBV.

To evaluate the outcomes of the vaccination intervention, a contingency table was constructed. The table had two rows and two columns. The rows represented the two groups: one for the newborns of mothers who were seropositive for hepatitis B and one for the newborns of mothers who were seronegative. The columns represented the

outcomes: the presence or absence of mother-to-child transmission of HBV. This structure allowed for a clear comparison of the effectiveness of the hepatitis B vaccine in preventing transmission from mothers to their infants, based on the mothers' serological status. The analysis of the contingency table provided valuable insights into the success of the vaccination strategy in reducing the vertical transmission of HBV in the studied population.

Table 2: Contingency table for objective 5

	Transmitted HBV	Not transmitted HBV
Vaccine Group	A	B
Control Group	C	D



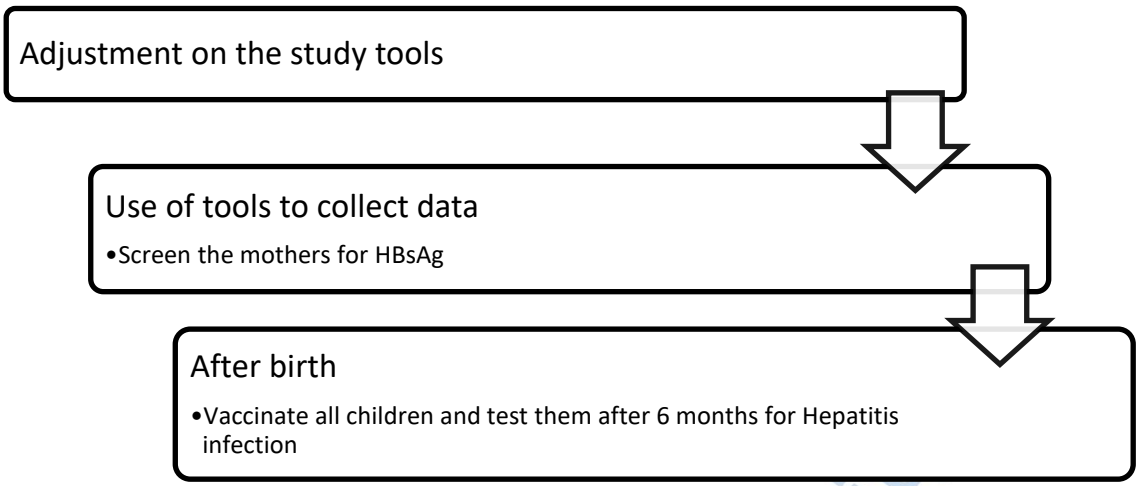


Figure 5: Data collection Procedure flow chart

3.7.1.3 Validity of the instrument

Validity refers to the extent to which the study findings accurately reflect the phenomenon being investigated, ensuring that the research instruments measure what they are intended to measure. In this study, content validity was prioritized by seeking input from subject matter experts, including supervisors and seasoned researchers, to verify that the instruments—specifically the questionnaires—adequately captured the variables under investigation. These experts offered valuable feedback on the clarity, relevance, and comprehensiveness of the items, which facilitated refinement of the research tools. This process ensured that the instruments aligned with the study's objectives and captured the full range of factors influencing Hepatitis B transmission and prevention.

Content validity also involved examining whether the sample selected for the study was representative of the broader population. This step was crucial in ensuring that the findings could be generalized and applied to the wider population, thus enhancing the study's external validity. The research questions incorporated into the questionnaires were meticulously crafted to ensure that each variable being investigated was

adequately reflected, allowing for a comprehensive exploration of the key issues surrounding Hepatitis B prevention.

To further ensure the robustness and reliability of the research instruments, construct validity was assessed using data from the pilot research phase. Factor analysis was employed to evaluate whether the data collected accurately represented the underlying constructs of the study. This statistical technique helped identify how well the variables in the questionnaires corresponded to the theoretical constructs they were designed to measure. By analyzing the factor structure, the study was able to confirm that the research model was solid and reliable, ensuring that the instruments would produce valid and meaningful results during the main data collection phase. This careful validation process was essential for enhancing the overall quality of the research and ensuring the accuracy of the findings.

3.7.1.4 Reliability of Instrument

Reliability analysis is a critical method used to determine the consistency of a measurement process, ensuring that repeated measurements under the same conditions yield the same results. Essentially, it assesses how often the same result can be expected from a measurement procedure when repeated over time (Toke et al., 2012). This aspect of the study is vital for ensuring that the data collected is stable, consistent, and dependable.

To ensure the reliability of the findings in this study, three research assistants were thoroughly trained. The training aimed to equip them with the skills and knowledge necessary for effective data collection while also minimizing the risk of errors during the process. The chief investigator played a key role in overseeing the data collection

process to further ensure that mistakes were minimized and that the data collected adhered to the required standards for accuracy and consistency.

In addition to this training, a test-retest approach was employed to assess the reliability of the data collection instruments. This approach involved administering the same instrument at two different points in time to the same participants to determine whether the results remained consistent. The purpose of the test-retest method was to evaluate whether the instruments produced stable and consistent results over time.

Moreover, to enhance the reliability of the instruments, a pilot study was conducted prior to the main data collection phase. A total of 38 participants were recruited from a nearby Primary Health Care Center (PHCC) for this pilot testing phase. The results from this pilot phase were then entered into SPSS software for analysis. Cronbach's Alpha coefficient was calculated to assess the internal consistency of the data collection tools. Values above 0.7 were considered acceptable, indicating that the instrument had a reliable level of internal consistency. Conversely, values below 0.5 were deemed unacceptable, suggesting that the instruments required further revision. This process ensured that the research instruments were sufficiently reliable for use in the main study, thereby strengthening the validity of the research findings.

3.7.2 Focus Group Discussion (FGD)

The research objectives were meticulously designed to offer a comprehensive exploration of various dimensions related to Hepatitis B among pregnant women in the Abyei region. These objectives aimed to assess the levels of awareness and perceptions regarding Hepatitis B, evaluate the effectiveness of current vaccination efforts, and identify the challenges and barriers hindering the prevention of vertical transmission

from mother to child. By addressing these key aspects, the study sought to provide a holistic understanding of the factors influencing Hepatitis B prevention in the region.

To capture a wide range of insights, the study identified pregnant women, healthcare providers, and traditional birth attendants as the primary groups of interest for participation. Recruitment efforts were strategically carried out across local healthcare facilities, community settings, and county health departments to ensure a diverse and representative sample of participants. Clear and transparent information about the purpose, process, and expected duration of the Focus Group Discussions (FGDs) was provided to all participants in advance, ensuring that they were fully informed and prepared for their involvement.

A tailored Focus Group Discussion Guide was carefully crafted to steer the conversations in a direction that would facilitate rich, detailed responses. The guide addressed critical topics, such as risk factors for Hepatitis B, the participants' levels of awareness about the virus, and the specific challenges they faced in preventing vertical transmission. To achieve data saturation, a total of five FGD sessions were conducted. These sessions allowed for in-depth discussions and provided valuable insights into the lived experiences and perspectives of the participants.

Throughout the process, the discussions fostered an open exchange of ideas, uncovering the various barriers and challenges associated with the prevention of Hepatitis B in the context of pregnancy and childbirth. By achieving data saturation, the study ensured that the information gathered was comprehensive and adequately reflected the full spectrum of experiences, opinions, and perceptions of the target population. This methodological approach not only strengthened the validity of the

study but also provided a nuanced understanding of the factors impacting Hepatitis B prevention efforts in Abyei.

3.7.3 Key informant Interviews (KII)

In the Key Informant Interviews (KII) phase, individuals with specialized expertise and extensive experience in the healthcare sector were purposefully selected to provide valuable insights into the study. These included healthcare professionals such as midwives, clinical officers, and doctors who were actively involved in the healthcare facilities serving the target population. The selection of these participants was based on their direct involvement in the management and care of pregnant women and their knowledge of Hepatitis B prevention and treatment.

Before the interviews were conducted, local health authorities were duly notified, and formal invitations were extended to the identified participants. This process ensured that the study complied with ethical standards, including proper notification and respect for local healthcare protocols. Only those participants who voluntarily agreed to take part in the study were interviewed, ensuring that their participation was based on informed consent, free from any coercion.

The interviews provided an opportunity to gain in-depth perspectives on various aspects of Hepatitis B management, including challenges in diagnosis, prevention, and treatment, as well as the perceived barriers to the effective implementation of vaccination and screening programs. Through these conversations, the research team was able to gather invaluable insights from healthcare professionals about the strengths and weaknesses of the current healthcare infrastructure, the role of local policies, and the potential improvements needed to address the Hepatitis B epidemic in the community.

The data obtained from the Key Informant Interviews enriched the overall depth and breadth of the research findings. The contributions of these professionals highlighted the multifaceted nature of Hepatitis B infection management and underscored the importance of healthcare provider engagement in the successful prevention and treatment of the disease. These insights played a critical role in informing recommendations for policy and practice improvements within the community healthcare context.

3.8 Data Analysis Technique

3.8.1 The quantitative data

The quantitative data collected for this study underwent a rigorous process of cleaning, organization, and coding before being analyzed using the Statistical Package for the Social Sciences (SPSS) version 29.0. The cleaning process ensured that any inconsistencies, errors, or missing values in the data were addressed, thereby enhancing the accuracy and reliability of the dataset. After the data were cleaned, they were organized and coded to facilitate efficient analysis, with each variable clearly defined and prepared for statistical evaluation.

Descriptive statistics were employed as the first step in the data analysis to summarize and describe the key features of the dataset. This included the use of charts, percentages, means, and standard deviations to provide an overview of the distribution and central tendencies of the data. Descriptive statistics helped to illustrate the interconnections among the different research aspects, offering a clear understanding of the characteristics of the study population, as well as any notable patterns or trends.

In addition to descriptive statistics, inferential statistics were utilized to examine the relationships between the variables in the study. Specifically, multilinear regression

analysis was conducted to test the associations between multiple independent variables and the dependent variables. This statistical approach allowed for the identification of potential causal relationships and the estimation of the strength of these associations. The regression analysis adhered to a significance level of 0.05, which is commonly used to assess the probability that the observed results are not due to random chance.

By combining both descriptive and inferential statistics, this analytical approach provided a comprehensive understanding of how the various variables in the research framework were related to each other. It also offered valuable insights into potential patterns, trends, and causal relationships that could inform the study's conclusions and recommendations. This rigorous data analysis process was key to deriving meaningful and reliable findings that contribute to the body of knowledge on Hepatitis B prevention and management.

3.8.2 The Qualitative Data Analysis

In the qualitative data analysis phase, narratives were constructed around the key themes that emerged from the data, with accompanying word boxes and sub-themes to provide clarity and structure. These themes were identified through a careful process of coding and categorizing the qualitative responses, which allowed for a detailed exploration of participants' perspectives. The identified themes were then critically analyzed within the context of the study's theoretical frameworks, ensuring that the findings were interpreted in a manner that was consistent with the theoretical underpinnings of the research. This process provided a nuanced understanding of the data, highlighting not only the explicit responses but also the implicit insights embedded within the qualitative narratives.

To enhance the robustness and validity of the findings, the qualitative results were meticulously triangulated with the quantitative data. This triangulation process allowed for a comprehensive understanding of the factors influencing Hepatitis B infection and vaccine efficacy, integrating the numerical patterns observed in the quantitative analysis with the rich, contextual insights from the qualitative data. By combining these two data sources, the study was able to offer a more holistic perspective on the research questions, addressing the complexity of Hepatitis B transmission, prevention, and vaccination strategies from both statistical and experiential viewpoints.

This integrative approach facilitated the exploration of intricate relationships, contextual nuances, and underlying dynamics that may not have been immediately evident through quantitative analysis alone. It provided a deeper understanding of the multifaceted nature of Hepatitis B prevention and management, ensuring that both the lived experiences of participants and the statistical data were given equal weight in the interpretation of the findings. Ultimately, this comprehensive analysis enriched the depth and breadth of the study's findings, offering a more nuanced interpretation of the factors influencing Hepatitis B infection and the effectiveness of vaccination efforts in the target population.

Table 3: Summary of research objective analysis

Objective 1: To determine viral hepatitis B seroprevalence among pregnant mothers seeking antenatal services in selected primary health care clinics in Abyei, South Sudan	**Descriptive statistics** Frequency distribution was used to present the number and percentage of pregnant women who are Hepatitis B positive.	**Inferential statistics** Chi-square tests or logistic regression was used to examine differences in prevalence between groups (e.g., by age, parity, risks, socioeconomic status).
Objective 2: To assess Awareness of Hepatitis B among pregnant mothers at antenatal clinics in Abyei, South Sudan.	**Descriptive statistics** Measures of central tendency and variability (standard deviation, range, interquartile range) was used to describe the level of awareness	**Inferential statistics** Chi-square test was used to assess the association between awareness hepatitis B and factors such as age, education level, socio-economic status of the pregnant mothers etc..

Objective 3: To investigate risk factors, barriers and challenges associated with viral hepatitis B prevention among pregnant mothers at antenatal Clinics in Abyei, South Sudan.		**Inferential statistics** Logistic regression was used to identify risk factors associated with Hepatitis B infection. Each factor (e.g., age, sexual behavior, drug use, etc) would be an independent variable in the model, and Hepatitis B status (infected vs. not infected) would be the dependent variable.
Objective 4: To evaluate the effectiveness of hepatitis B vaccine in preventing mother-to-child Transmission among pregnant mothers at antenatal Clinics in Abyei, South Sudan		**Inferential statistics** Chi-square test was used to compare the rates of vertical transmission Between exposed and unexposed newborns who are vaccinated. Alternatively, logistic regression was used to control for other factors that might influence transmission.

3.9 Ethical Consideration

Prior to commencing the study, ethical approval was diligently sought from the Mount Kenya University Institutional Scientific, Research Ethical Review Committee (ISREC). Additionally, authorization from the Abyei State/National Ministry of Health was requisite to endorse the study on behalf of the Government. Prior to engaging in the study, explicit informed consent was conscientiously obtained from all participating individuals. These participants were furnished with lucid and comprehensible information elucidating the study's objectives, methodologies, potential hazards, advantages, and their prerogative to decline or retract from the study at any juncture sans facing repercussions.

It was unequivocally underscored that involvement in the study was wholly voluntary, devoid of any coercion or duress. Participants were explicitly informed of their entitlement to abstain or withdraw from the study sans any deleterious ramifications on their healthcare or receipt of other services. Ensuring the sanctity of their privacy and confidentiality, stringent measures were implemented to safeguard participants'

personal data. All data procured underwent anonymization and were securely stored to thwart unauthorized access, with any personal identifiers diligently avoided in study documentation or publications.

Concomitantly, meticulous precautions were adopted to mitigate potential risks to the participants, ensuring that the study procedures remained benign and inflicted no undue harm or discomfort. Furthermore, stringent infection control measures were diligently enforced during the collection of blood samples to obviate the transmission of any infectious agents.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents findings from field data collection and discussion. The chapter provides the information on response rate, then sociodemographic information of the respondents, findings on seroprevalence of Hepatitis B, findings on awareness of hepatitis B, risk factors of the hepatitis B among the participants, findings on barriers and challenges to hepatitis prevention programs. The chapter end by presenting findings on effectiveness of hepatitis B in preventing mother-to-child transmission of hepatitis B among pregnant mothers in the study area.

4.2 Response Rate

The purpose of this study was to evaluate the seroprevalence of Hepatitis B and the effectiveness of vaccination in preventing vertical transmission among pregnant mothers attending antenatal clinics in Abyei, South Sudan. To achieve this, the study adhered to Mitchell et al. (2021), which states that the survey response rate should be calculated as the number of completed and returned questionnaires divided by the total sample initially targeted.

In the first phase of the study, a total of 384 pregnant mothers were recruited. Out of these, 382 questionnaires were completed and returned, resulting in an exceptionally high response rate of 99%. The second phase involved registering 94 infants born to the participating mothers. All 94 infants were present and accounted for in the study, achieving a perfect response rate of 100% for this phase.

These high response rates reflect the rigorous engagement and follow-up strategies employed during the study, ensuring comprehensive participation and reliable data

collection to assess the critical issues of Hepatitis B prevalence and vaccine effectiveness in the region.

4.3 Seroprevalence of Hepatitis B among Pregnant Mothers

Figure 4.1 presents the seroprevalence among pregnant mothers seeking antenatal care in Abyei South Sudan. Few of the study participants (19%) were diagnosed with viral hepatitis B; 81% were negative.

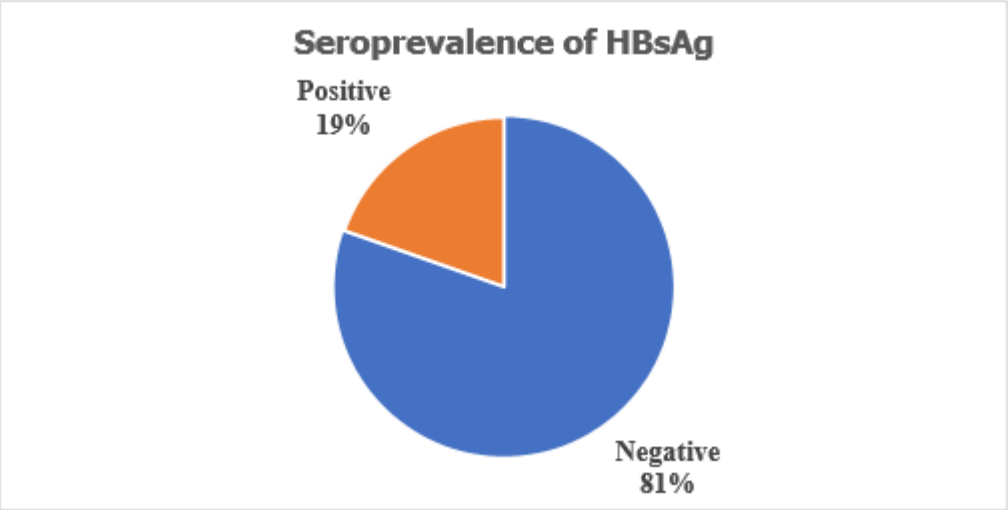


Figure 6: Seroprevalence of Hepatitis B among pregnant mothers
Source: Research Data, 2024

4.4 Awareness of Hepatitis B among pregnant mothers

Table 4 illustrates the level of awareness among pregnant women at antenatal clinics in Abyei South Sudan. All study participants interviewed were not aware of hepatitis B.

Table 4: Awareness index of Hepatitis B among pregnant mothers

Level of Awareness	Freq.	Percent
not aware	382	100.0
Total	382	100

Source: Research Data, 2024

4.5 Risk factors associated with viral hepatitis B infection

Table 4.2 presents the bivariate association of risk factors associated with hepatitis B seroprevalence among women at antenatal clinics. Age of first sexual life χ^2 (*6.1212 (1), p= 0.013)*, having an incident of STI χ^2 (154.6550, (df=2), *p = 0.000)*, use of IV drugs χ^2 (54.7617, (df=1*) p= 0.000)*, and piercing nose or ear χ^2 (*18.4305 (df=1) p= 0.000)* were significantly associated with Hepatitis B seroprevalence.

Qualitative data was generated and triangulated as follows

"Unskilled delivery is common among women in this area and poses a risk of hepatitis B to both mother and her child"

"Pregnant mothers don't turn up for antenatal care and this carries risk of undiagnosed hepatitis B from mother to child"

"Having multiple sexual partners is being practiced by some people"

"There is wife inheritance in community where men inherit wives of late relatives who died of hepatitis B"

"Ear and nose piercing using non-disposable instruments is practiced among women and this is a risk of infection"

"Lack of knowledge and awareness of hepatitis B and its transmission route" "Weak health system and low quality of care in the clinics that may lead to poor infection control"

"Gender based violence including rape are coming up nowadays due to insecurity and victims are at risk of Sexually transmitted illnesses including Hepatitis B"

Table 5: Risk factors associated with viral Hepatitis B infection

	HBsAg result		
Age of sexual life	**Negative**	**Positive**	**Total**
13-15 years	173(56.4)	54(72.0)	*6.1212 (df=1), p= 0.013*
16 years and above	134(43.7)	21(28.0)	
Suffering from STI			
No	263(85.7)	10(13.3)	154.6550, (df=2), *p =*

Yes	44(14.3)	65(86.7)	*0.000*
Ever used by IV drugs			
No	232(75.6)	23(30.7)	54.7617, (df=1) p= 0.000
Yes	75(24.4)	52(33.3)	
Husband living with HBV			
No	300(97.7)	58(77.3)	42.5457 (df=1) p = 0.000
Yes	7(2.3)	17(22.7)	
Have you pierced your nose or ear	No	Yes	
No	63(20.5)	0(0.0)	18.4305 (df=1) p= 0.000
Yes	244(79.5)	75(100.0)	

Source: Research Data, 2024

Logistic regression analysis illustrates that respondents who have ever had a sexually transmitted disease were 12 times more likely to test positive for Hepatitis B compared to those who did not have STIs (*A.O.R=12.848, p=0.0001*). The use of intravenous drugs was also a predictor of testing positive for hepatitis B. The probability 2.3 times of testing Hepatitis B positive if a pregnant woman uses intravenous drugs. (*A.O. R=2.3, p=0.004*)

Table 6: Predictors of HBV

Age of start of sexual life	**Odds ratio**	**Std. err.**	**z**	**P>z**	**[95% conf. interval]**	
13-15 years	Ref			*0.968*	Lower	Upper
16 years and above	0.982	0.434	-0.041		0.413	2.337
Had surgical operation						
No	Ref			*0.726*		
Yes	1.169	0.52	0.35		0.489	2.794
Have STI						
No	**Ref**			*0.0001*		
Yes	12.848	6.388	5.135		4.848	34.045
Currently using IV Drugs						
No	**Ref**			*0.04*		
Yes	2.3	0.894	2.051		1.037	4.904
Living with someone infected with Hepatitis B						
No	**Ref**			0.25		
Yes	1.84	0.976	1.15		0.651	5.205

Constant	0.059	0.026	-6.517	0	0.025	0.139

Source: Research Data, 2024

4.6 To identify barriers and challenges in viral hepatitis B prevention

The focus group discussions also identified several barriers and challenges to the prevention of hepatitis B among pregnant women. *These include the lack of screening services specifically tailored for pregnant women, as well as the absence of prophylactic hepatitis B services for infants born to positive mothers. Limited awareness-raising activities and the low socio-economic status of the population were highlighted as additional challenges. Other barriers mentioned include the absence of linkages to treatment services, limited access to antenatal care, and the low skills and training levels among healthcare workers. Cultural beliefs, taboos, and the affordability and availability of vaccines were also identified as significant challenges. Furthermore, the collapsed health system was noted as a contributing factor, leading to inadequate supply chains and exacerbating the challenges of hepatitis B prevention.*

4.7 Effectiveness of Hepatitis B Vaccine

A cohort of infants of pregnant mothers who tested positive (N=47) were followed up to ascertain the effectiveness of the hepatitis B vaccine in preventing mother-to-child transmission among their infants. A similar proportion was matched against cases for comparison. Among those who tested positive, two children from cases (mothers who were diagnosed with hepatitis B) tested positive. The risk ratio was 2.044 (C.I 1.659-2.519) There was no statistical association *(fisher's exact p= 0.4946)*.

Table 7: Analysis of pregnant mothers who tested for Hep B and Child Hep B outcome

	Exposed	Unexposed	Total
Cases	2	45	47
Non-cases	0	47	47
Total	2	92	94

Risk	1	0.489	0.5
		Point estimate [95% conf. interval]	
		Lower	**Upper**
Risk difference	0.511	0.409	0.613
Risk ratio	2.044	1.659	2.519
Attr. frac. ex.	0.511	0.397	0.603
Attr. frac. Pop	0.022		
1-sided Fisher's exact p = 0.2473			
2-sided Fisher's exact p = 0.4946			

Source: Research Data, 2024

This survey followed up on child outcomes who were fully vaccinated and the probability of testing positive for hepatitis B. Table 4.8 illustrates that there was no significant statistical association between child vaccination status and the hepatitis seroprevalence (*RR: 0.719 (C.I 0.179-2.893) fisher's* exact *p = 0.5241)*

Table 4.8: The risk of being a case in the exposed group is 1, meaning all exposed infants are cases. The risk in the unexposed group is 0.489, meaning about 48.9% of the unexposed infants are cases. The risk difference is 0.511, means the absolute difference in risk between the exposed and unexposed groups is 51.1 percentage points. The risk ratio is 2.044. This means that the risk of the outcome in the exposed group is approximately 2.044 times the risk in the unexposed group. Hence exposure to hepatitis B is associated with more than doubling the risk of the outcome measured. Attributable Fraction Among the Exposed (Attr. frac. ex.) This value is 0.511, indicating that is 51.1% of the risk in the exposed group is attributable to the exposure to Hepatitis B Attributable Fraction in the Population (Attr. frac. Pop) This value is 0.022, suggesting that 2.2% of the risk in the total population (both exposed and unexposed) is attributable to being in the exposed group. 95% Confidence Interval for the Risk Ratio The lower bound of the confidence interval is 0.409, and the upper bound is 0.613. This wide confidence interval indicates a high level of uncertainty around the risk ratio estimate, likely due to the small sample size, particularly of the exposed group (only 2 infants).

4.8 Testing the hypothesis

The chi-square test was used to examine the hypothesis regarding the potential difference in the rate of hepatitis B virus (HBV) transmission from mother to child between infants born of Hepatitis B surface Antigen (HBsAg) positive mothers who received the hepatitis B vaccine and those infants born of mothers who tested negative of HBsAg and who also vaccinated. The specific presumption that was examined was as follows:

Null Hypothesis (H0): There is no difference in the rate of mother-to-child transmission of hepatitis B virus (HBV) between infants of HBsAg positive mothers who received the hepatitis B vaccine and those whose mothers are negative and have also received the vaccine

The p-value from the chi-square test was 0.5241. The fact that this p-value is higher than the conventional significance level of 0.05 indicates that insufficient data exist to completely rule out the null hypothesis.

Based on the statistical analysis, it is not possible to conclude that infants born of mothers with HBsAg positive status who were vaccinated against hepatitis B had a significantly lower rate of HBV transmission from mother to child than those infants whose mothers tested negative.

Table 8: Child vaccination status and child having developed Hepatitis B

	Exposed	Unexposed	Total
Cases	1	64	65
Non-cases	1	28	29
Total	2	92	94
Risk	0.5	0.696	0.691
Risk difference	-0.196	-0.895	0.504
Risk ratio	0.719	0.179	2.893
Prev. frac. ex.	0.281	-1.893	0.821
Prev. frac. Pop	0.006		

1-sided Fisher's exact p = 0.5241

2-sided Fisher's exact p = 0.5241

Source: Research Data, 2024

4.9 Discussion

4.10 Viral hepatitis B seroprevalence among pregnant mothers

The study conducted in Abyei, South Sudan, highlights a significant public health concern regarding the prevalence of viral hepatitis B among pregnant women seeking antenatal care services. The findings reveal a striking seroprevalence rate of 19% among this population, classifying Abyei as a region with a high endemicity for hepatitis B. According to the World Health Organization (WHO, 2022), areas with a hepatitis B prevalence of 8% or more are considered high-endemic regions, while areas with a prevalence of 2% or lower are classified as low-endemic regions. The prevalence identified in Abyei far surpasses the threshold for high endemicity, underscoring the severity of the issue in this region. This high prevalence rate among pregnant women in Abyei mirrors trends observed across other countries in sub-Saharan Africa and emphasizes the need for urgent and effective public health measures to prevent and control the transmission of the hepatitis B virus (HBV).

When the findings from Abyei are compared to global prevalence rates, the disparities become starkly evident, highlighting the heightened burden of hepatitis B in this region. For instance, studies conducted in Oman and Spain reported significantly lower prevalence rates of 1.49% and 0.42%, respectively (Al-Ismaili et al., 2022; Ruiz-Extremera et al., 2020). These rates are strikingly low when juxtaposed with the prevalence in Abyei. Similarly, in China, where the prevalence rate was found to be 7.9% (Liu et al., 2020), the burden is nearly half that reported in Abyei. Even within Europe, a study conducted in Spain documented a prevalence rate of 12.9% among

pregnant women, which is still considerably lower than the alarming rate observed in Abyei (Miyakawa et al., 2021).

Interestingly, the prevalence rates observed in Abyei are consistent with those reported in other sub-Saharan African nations, where hepatitis B remains a persistent public health challenge. For instance, in Ethiopia, a study conducted in Addis Ababa revealed a seroprevalence rate of 19.1% among pregnant women, which is slightly higher than the prevalence identified in Abyei (Desalegn et al., 2020). Similarly, in West Africa, particularly in Nigeria and Ghana, seroprevalence rates among pregnant women were reported to range from 17.3% to 17.7%, closely aligning with the findings from Abyei (Nnaemeka et al., 2020; Donkor et al., 2018).

However, the findings from Abyei also contrast with some studies conducted in neighboring countries. For example, in Sudan, prevalence rates among pregnant women varied significantly, with reported seroprevalence rates ranging from 5.6% to 12.8% in different studies (Elsheikh et al., 2016; Ahmed et al., 2017). These rates are notably lower than the 19% prevalence documented in Abyei, highlighting regional variations even within neighboring areas. Similarly, research conducted in different regions of Ethiopia reported prevalence rates ranging from 4.7% to 8% among pregnant women attending antenatal clinics (Umer et al., 2023), which are significantly lower than the rates found in Abyei. In Uganda, a study reported an even lower prevalence of 2.1% among pregnant women (Mugabiirwe et al., 2022). Furthermore, a study conducted in Ghana's tertiary hospitals identified a prevalence rate of 6% among pregnant women (Antuamwine, Herchel & Bawa, 2022). These disparities in prevalence rates across regions and countries underscore the complex interplay of socio-economic, cultural, and healthcare-related factors influencing hepatitis B transmission dynamics.

In addition to its quantitative findings, the study conducted in Abyei integrated a qualitative component to provide a deeper understanding of the perceptions, beliefs, and challenges associated with the burden of hepatitis B among pregnant women in the region. This aspect of the research utilized Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), allowing participants to share their insights and experiences regarding the disease. These qualitative methods enriched the study by capturing the social and contextual dimensions of hepatitis B, which are often not fully revealed through quantitative data alone. The findings from these discussions offer a nuanced perspective on the challenges faced by the community in combating hepatitis B and highlight areas requiring immediate attention.

Participants in the FGDs and KIIs expressed diverse views about the perceived burden of hepatitis B within their community. Some individuals viewed hepatitis B as a significant and widespread problem, emphasizing its detrimental impact on both individual and public health. These participants highlighted the prevalence of the disease and its long-term complications, such as liver cirrhosis and cancer, which they felt posed a substantial threat to the community. On the other hand, some participants believed that the burden of hepatitis B ranged from moderate to high but lacked concrete data or experiences to support these claims. This variability in perceptions underscores the broader challenges of awareness and understanding of hepatitis B among the population.

A critical issue raised during these discussions was the lack of adequate testing facilities within Abyei. Participants consistently pointed out that the absence of accessible and functional diagnostic services limits the ability to accurately assess the true scale of hepatitis B prevalence in the region. Without reliable testing, many cases likely remain undiagnosed, contributing to an underestimation of the disease's burden.

This gap not only affects individual health outcomes but also hampers the development and implementation of targeted public health interventions. Accurate data is essential for allocating resources effectively, prioritizing interventions, and evaluating the impact of prevention and treatment strategies. The absence of such data due to inadequate testing infrastructure creates significant barriers to progress.

The lack of diagnostic services also creates uncertainty and anxiety within the community. Participants expressed concerns that the inability to test for hepatitis B perpetuates a cycle of ignorance about the disease. This ignorance extends beyond individuals to the healthcare system itself, as providers may lack the information needed to make informed decisions about prevention and treatment programs. This disconnect between the perceived and actual burden of hepatitis B highlights the pressing need for investment in healthcare infrastructure to support diagnostic capacity. Without this foundation, efforts to address hepatitis B in Abyei are likely to remain fragmented and ineffective.

Beyond testing, the qualitative findings revealed additional challenges related to healthcare access and resource availability. Participants frequently mentioned the scarcity of medical supplies, including vaccines and treatments, which further exacerbates the difficulty of managing hepatitis B in the community. Healthcare workers often face logistical challenges in delivering care, including transportation barriers, limited workforce capacity, and inconsistent supply chains. These issues compound the broader problem of healthcare delivery, leaving many residents of Abyei without the resources needed to prevent or treat hepatitis B effectively.

The discussions also touched on socio-cultural factors influencing the response to hepatitis B. Participants noted that limited awareness campaigns and health education

initiatives have left significant gaps in knowledge about the disease. Many community members lack a clear understanding of how hepatitis B is transmitted, its potential complications, and the importance of preventive measures such as vaccination. This lack of awareness contributes to stigmatization and misconceptions about the disease, making it even harder for individuals to seek testing or treatment. Addressing these socio-cultural barriers is essential for fostering a supportive environment where hepatitis B can be tackled openly and effectively.

The qualitative findings from this study underscore the urgent need for improved healthcare infrastructure in Abyei. Establishing diagnostic services that are accessible and affordable is a critical first step. These services should be integrated into existing healthcare facilities and supported by trained personnel who can ensure accurate testing and counseling. Investments in healthcare infrastructure should also include the development of a reliable supply chain for medical supplies, ensuring consistent availability of vaccines, antiviral medications, and other essential resources.

Equally important is the need for comprehensive health education and community engagement initiatives. Raising awareness about hepatitis B and its prevention can help dispel myths and reduce stigma associated with the disease. Community-based programs that involve local leaders and trusted figures can play a pivotal role in promoting understanding and encouraging individuals to seek care. Such initiatives can also empower communities to advocate for improved healthcare services, creating a groundswell of support for policy changes and resource allocation.

Addressing the challenges highlighted in the qualitative component of this study requires a coordinated and multi-faceted approach. Strengthening healthcare infrastructure, expanding access to diagnostic services, and fostering community

awareness are essential steps in reducing the burden of hepatitis B in Abyei. By prioritizing these efforts, public health officials can create an environment where hepatitis B is no longer a hidden or underestimated threat but a manageable condition with clear pathways for prevention and treatment.

The findings of this study highlight the urgent need for tailored public health interventions to address the significant burden of hepatitis B among pregnant women in Abyei, South Sudan. In high-endemic regions like Abyei, mother-to-child transmission (MTCT) represents one of the primary routes of hepatitis B virus (HBV) spread. This mode of transmission perpetuates the disease cycle, as infants born to HBV-positive mothers are at a high risk of developing chronic hepatitis B. Chronic infection, in turn, significantly increases the likelihood of severe liver conditions, such as cirrhosis or hepatocellular carcinoma, later in life. Without effective preventive measures, MTCT poses a severe threat to public health and maternal and child health outcomes in the region, necessitating immediate intervention.

Preventing MTCT is critical in breaking the chain of hepatitis B transmission. During childbirth, infected mothers can pass the virus to their infants, leading to long-term health complications for the child. The high prevalence of hepatitis B among pregnant women in Abyei underscores the scale of this challenge and calls for robust public health strategies to prevent transmission and improve health outcomes for both mothers and their children. Addressing this issue effectively requires a comprehensive, multi-pronged approach focused on prevention, early detection, and treatment.

A critical first step in combating hepatitis B in Abyei is to enhance testing infrastructure. Timely and accessible testing services are essential for identifying infected individuals, particularly among pregnant women, who are a key population for

targeted intervention. Comprehensive testing programs can provide the data needed to guide appropriate preventive measures and ensure timely treatment for those affected. Integrating hepatitis B screening into routine antenatal care is a highly effective strategy for achieving this goal. Pregnant women represent a population that regularly interacts with healthcare services, making antenatal care a valuable platform for screening initiatives. Offering hepatitis B testing as part of standard antenatal care can ensure that more women are screened during pregnancy, facilitating early diagnosis and enabling targeted interventions.

Early identification of hepatitis B-positive mothers is vital for reducing MTCT risk. Once diagnosed, healthcare providers can implement preventive measures, such as administering antiviral prophylaxis or hepatitis B immunoglobulin (HBIG) therapy, which significantly lower the likelihood of vertical transmission during childbirth. In addition, newborns of HBV-positive mothers can receive the birth dose of the hepatitis B vaccine within 24 hours of delivery, a measure that has proven highly effective in preventing chronic infection. Combining maternal interventions with neonatal vaccination ensures a multi-layered approach to preventing transmission and protecting infants from lifelong health complications.

Improving access to diagnostic tools and expanding the availability of healthcare services are crucial components of this strategy. In Abyei, the lack of functional diagnostic facilities poses a significant barrier to addressing the hepatitis B burden. Many pregnant women in the region have limited access to testing, leading to undiagnosed cases and missed opportunities for intervention. Addressing this gap requires substantial investment in healthcare infrastructure to establish diagnostic services in both urban and rural areas. Mobile clinics and outreach programs can also

be utilized to reach women in remote communities who might otherwise lack access to healthcare.

Another essential aspect of addressing hepatitis B in Abyei is increasing awareness and education about the disease. Limited knowledge about hepatitis B, its transmission routes, and its health implications remains a significant barrier to prevention. Many women may be unaware of the importance of screening during pregnancy or the availability of preventive measures for their infants. Community-based health education campaigns are critical for dispelling myths, reducing stigma, and encouraging women to seek testing and treatment. Engaging local leaders and community health workers in these efforts can improve outreach and ensure that educational messages are culturally appropriate and widely disseminated.

Vaccination plays a central role in preventing hepatitis B transmission and reducing the overall disease burden. In regions like Abyei, where the prevalence of hepatitis B is high, ensuring access to the hepatitis B vaccine is particularly important. The WHO recommends administering the birth dose of the vaccine within 24 hours of delivery, followed by additional doses according to the national immunization schedule. However, logistical challenges such as vaccine shortages, limited cold chain facilities, and inadequate healthcare staffing often hinder vaccination efforts in resource-limited settings. Overcoming these challenges requires strengthening supply chains, improving vaccine storage infrastructure, and providing training for healthcare workers on the administration and benefits of the hepatitis B vaccine.

Addressing the systemic barriers to vaccination is equally important. In many low-resource settings, financial constraints prevent families from accessing vaccination services. Offering free or subsidized vaccines can help increase uptake and ensure that

cost does not remain a barrier to protection. Governments and international organizations must collaborate to secure funding for vaccination programs and prioritize the inclusion of hepatitis B prevention initiatives in broader maternal and child health strategies.

In addition to improving vaccination coverage, targeted interventions to support hepatitis B-positive mothers are essential for effective disease management. Providing antiviral therapy to mothers with high viral loads during pregnancy can significantly reduce the risk of transmission. Regular monitoring and follow-up care for hepatitis B-positive women can ensure that they receive the support and treatment needed to manage their condition and prevent further complications. Such measures require a strong healthcare system capable of offering comprehensive care to affected individuals.

Community engagement is a cornerstone of successful public health interventions. In Abyei, involving community leaders, traditional healers, and religious figures in hepatitis B prevention efforts can foster trust and promote acceptance of screening and vaccination programs. These leaders can serve as advocates for health education, encouraging community members to participate in prevention initiatives and seek care without fear of stigma or discrimination. Addressing the cultural and social barriers to hepatitis B prevention is essential for building a supportive environment where individuals feel empowered to access healthcare services.

Stigma surrounding hepatitis B poses a significant challenge to prevention and treatment efforts in Abyei. Misconceptions about the disease and its transmission can lead to social isolation and reluctance to disclose infection status. Public health campaigns aimed at reducing stigma and increasing understanding of hepatitis B are

critical for overcoming this barrier. By normalizing conversations about the disease and highlighting the availability of effective preventive measures, these campaigns can encourage more individuals to seek testing and treatment.

Collaborative partnerships between governments, non-governmental organizations, and international agencies are essential for addressing the hepatitis B burden in Abyei. These partnerships can provide the financial and technical support needed to implement effective prevention and treatment programs. Donor funding can help bridge resource gaps, while technical assistance can support the development of healthcare infrastructure, training for healthcare providers, and the establishment of monitoring and evaluation systems. Coordinated efforts at the national and global levels are necessary to ensure that hepatitis B prevention remains a priority and that progress toward eliminating MTCT is sustained.

Research and data collection are also vital for informing public health strategies and tracking progress in addressing hepatitis B. Regular surveillance of hepatitis B prevalence and vaccination coverage can provide insights into the effectiveness of interventions and identify areas for improvement. Investing in research to better understand the local epidemiology of hepatitis B, including risk factors for transmission and barriers to care, can guide the development of tailored approaches to prevention and treatment in Abyei.

Finally, integrating hepatitis B prevention into broader maternal and child health initiatives can maximize the impact of public health efforts. Combining hepatitis B screening and vaccination with other antenatal and postnatal services can streamline care delivery and ensure that women and children receive comprehensive support. This

approach not only improves health outcomes for those at risk of hepatitis B but also strengthens the overall healthcare system by promoting efficiency and resource-sharing.

Vaccination is one of the most effective tools in preventing hepatitis B transmission, and its importance cannot be overstated, particularly in regions with high prevalence rates such as Abyei, South Sudan. The World Health Organization (WHO) has long recommended that all infants receive the hepatitis B vaccine within 24 hours of birth, commonly referred to as the birth dose. This crucial intervention is followed by additional doses as part of national immunization schedules to ensure robust protection against the virus. Timely vaccination is vital in breaking the chain of hepatitis B transmission, especially in high-endemic areas where mother-to-child transmission (MTCT) remains a significant contributor to the disease burden. In Abyei, where hepatitis B prevalence among pregnant women is alarmingly high, ensuring that newborns receive the birth dose of the vaccine is a critical component of any comprehensive prevention strategy.

The hepatitis B birth dose vaccine serves as a first line of defense, protecting infants from acquiring the virus during childbirth, one of the primary routes of transmission in high-endemic regions. This single intervention can prevent chronic hepatitis B infection, which poses a lifetime risk of severe complications such as cirrhosis and hepatocellular carcinoma. The inclusion of hepatitis B vaccination in routine immunization schedules has significantly reduced the prevalence of the disease in many parts of the world. However, in resource-limited settings like Abyei, achieving universal coverage for the birth dose remains a major challenge due to systemic barriers, logistical constraints, and a lack of awareness.

To effectively combat hepatitis B in Abyei, vaccination campaigns must target high-risk populations, including pregnant women and their families. Pregnant women play a crucial role in reducing MTCT, and ensuring they are aware of the importance of the birth dose vaccine for their newborns is essential. Campaigns that focus on increasing awareness about the availability and benefits of vaccination can help encourage families to prioritize this life-saving intervention. Healthcare providers should also be trained to emphasize the importance of vaccination during antenatal visits, providing mothers with the information and resources they need to protect their children from hepatitis B.

Overcoming logistical barriers is another critical component of improving vaccination coverage in Abyei. Limited access to healthcare facilities, particularly in rural and remote areas, often prevents timely administration of the birth dose vaccine. Many women in these regions give birth at home or in traditional settings where healthcare services are not readily available. Addressing this issue requires the implementation of innovative solutions such as mobile clinics and community health worker programs. These initiatives can bring vaccination services directly to underserved communities, ensuring that more infants receive the birth dose within the recommended 24-hour window after birth.

In addition to addressing accessibility, improving the supply chain for vaccines is essential. Maintaining an effective cold chain system is critical for preserving the efficacy of the hepatitis B vaccine during storage and transportation. In regions like Abyei, where infrastructure is often inadequate, investments in cold chain equipment and logistics are necessary to support the distribution of vaccines to even the most remote areas. Strengthening these systems will help ensure that healthcare facilities are consistently stocked with the vaccines they need to meet community demands.

Another challenge to achieving high vaccination coverage is the financial barrier faced by many families in Abyei. The cost of vaccines and associated healthcare services can be prohibitive for low-income households, limiting access to essential preventive measures. Governments and international organizations must work together to provide free or subsidized hepatitis B vaccines to ensure that financial constraints do not hinder efforts to protect newborns from infection. Funding for vaccination programs should also prioritize high-burden areas, ensuring that resources are allocated where they are needed most.

Vaccination alone, however, is not sufficient to eliminate hepatitis B. Raising awareness and educating the community about the disease is equally critical. In high-endemic regions like Abyei, limited knowledge about hepatitis B is a significant barrier to prevention and control. Many individuals lack an understanding of the modes of transmission, the risks of chronic infection, and the importance of vaccination. Misconceptions and stigma surrounding hepatitis B further exacerbate this issue, creating an environment where individuals may be reluctant to seek testing or preventive care.

Public health education campaigns can play a transformative role in addressing these gaps. These campaigns should aim to dispel myths and misconceptions about hepatitis B while promoting accurate information about the disease and its prevention. Using culturally appropriate messaging and engaging trusted community leaders can enhance the effectiveness of these efforts. For instance, religious leaders, traditional healers, and local chiefs can serve as influential advocates for hepatitis B awareness, encouraging community members to seek vaccination and testing.

Educational initiatives should also focus on the broader community, ensuring that families, caregivers, and healthcare providers all understand their roles in hepatitis B prevention. For example, educating fathers and other family members about the importance of timely vaccination can help foster a supportive environment where mothers feel encouraged to prioritize their children's health. Similarly, training healthcare providers to communicate effectively about hepatitis B can help bridge the knowledge gap and ensure that families receive accurate and consistent information.

Community engagement is another critical aspect of raising awareness and overcoming cultural and social barriers to hepatitis B prevention. In many high-endemic regions, cultural beliefs and practices can influence health-seeking behavior, sometimes hindering the uptake of preventive measures such as vaccination. Engaging communities in the planning and implementation of hepatitis B interventions can help address these barriers and build trust between healthcare providers and community members. For example, involving local stakeholders in vaccination campaigns can ensure that programs are culturally sensitive and tailored to the specific needs and preferences of the population.

Efforts to raise awareness should also address the stigma associated with hepatitis B. In some communities, individuals with hepatitis B may face discrimination or social exclusion, discouraging them from seeking care or disclosing their status. Public health campaigns should emphasize that hepatitis B is a preventable and manageable condition, helping to normalize conversations about the disease and reduce stigma. Encouraging open dialogue about hepatitis B can create a more supportive environment where individuals feel empowered to access testing, treatment, and vaccination services.

In addition to raising awareness at the community level, integrating hepatitis B education into school curricula and community-based programs can have a lasting impact. Teaching children and adolescents about hepatitis B and the importance of vaccination can help cultivate a generation that is better informed and more proactive about disease prevention. Similarly, incorporating hepatitis B education into existing maternal and child health programs can ensure that families receive consistent and accurate information throughout their interactions with the healthcare system.

To sustain progress in hepatitis B prevention and control, collaboration between governments, non-governmental organizations, and international agencies is essential. These partnerships can provide the financial, technical, and logistical support needed to implement effective vaccination and education programs in high-burden regions like Abyei. For example, donor funding can help address resource gaps, while technical assistance can support the development of healthcare infrastructure and the training of healthcare providers. Coordinated efforts can also help ensure that hepatitis B prevention remains a priority on national and global health agendas.

Monitoring and evaluation are crucial for measuring the impact of vaccination and education initiatives and identifying areas for improvement. Regular data collection on vaccination coverage, community awareness, and disease prevalence can provide valuable insights into the effectiveness of interventions and inform future strategies. Investing in research to better understand the local epidemiology of hepatitis B, including risk factors for transmission and barriers to care, can also guide the development of targeted approaches to prevention and control.

Healthcare workers play a central role in the fight against hepatitis B, particularly in high-burden settings. Training and capacity-building programs for healthcare providers

can enhance their ability to diagnose, manage, and prevent hepatitis B among pregnant women. Equipping healthcare facilities with the necessary resources, including diagnostic tools, vaccines, and antiviral medications, is essential to ensuring the effective delivery of care.

The high prevalence of hepatitis B among pregnant women in Abyei also has broader implications for healthcare systems in the region. The burden of hepatitis B places additional strain on already limited healthcare resources, particularly in conflict-affected areas like Abyei, where access to healthcare services is often constrained. Strengthening healthcare systems and building resilience in these settings is critical to addressing the dual challenges of high disease prevalence and limited resources.

this study sheds light on the substantial burden of hepatitis B among pregnant women in Abyei, South Sudan. The high seroprevalence rate of 19% not only highlights the severity of the issue but also underscores the urgent need for comprehensive prevention and control measures to curb mother-to-child transmission of the virus. Enhancing testing infrastructure, integrating hepatitis B screening into routine antenatal care, and promoting vaccination are critical components of an effective response. Furthermore, raising awareness, building the capacity of healthcare workers, and addressing systemic barriers to healthcare access are essential to reducing the impact of hepatitis B in Abyei and other high-prevalence regions. By implementing these targeted interventions, it is possible to improve maternal and child health outcomes and to break the cycle of hepatitis B transmission in high-endemic areas.

Through a combination of robust public health measures, improved healthcare infrastructure, and community engagement, the burden of hepatitis B in Abyei can be mitigated. These efforts would not only benefit the health and well-being of pregnant

women and their children but also contribute to the broader goal of reducing hepatitis B prevalence in high-burden regions worldwide. The findings from Abyei serve as a call to action for policymakers, healthcare providers, and researchers to prioritize hepatitis B prevention and to work collaboratively toward the goal of eliminating hepatitis B as a public health threat.

4.11 Awareness of Hepatitis B among pregnant mothers

The findings of this study reveal that none of the pregnant women in Abyei, South Sudan, were aware of the hepatitis B virus (HBV). This highlights a critical gap in public health knowledge and awareness in the region. Globally, awareness of hepatitis B among pregnant women exhibits significant variability, influenced by factors such as socioeconomic status, education level, healthcare access, and prevailing cultural beliefs. Understanding these disparities is crucial for designing effective interventions to improve awareness and prevention measures, especially in high-risk regions like Abyei.

In high-income countries, awareness of hepatitis B tends to be higher, largely due to well-established healthcare systems, comprehensive antenatal care services, and robust public health education campaigns. For example, a study conducted in the United States indicated that the majority of pregnant women had a good understanding of hepatitis B, including its modes of transmission and prevention strategies (Sánchez et al., 2018). This heightened awareness is often attributed to the availability of healthcare resources, mandatory screening programs, and widespread dissemination of information through various media platforms. These efforts have contributed to reducing the burden of hepatitis B in these countries.

In stark contrast, the situation in low- and middle-income countries paints a different picture. Limited access to healthcare, inadequate health education initiatives, and socio-cultural barriers often result in low levels of awareness about hepatitis B among pregnant women. For instance, a study conducted in rural areas of Pakistan revealed that most pregnant women had little to no knowledge of hepatitis B transmission and prevention methods (Ali et al., 2019). This lack of awareness directly impacts their ability to take preventive measures, increasing the risk of mother-to-child transmission (MTCT) of the virus. Similarly, a study conducted in India among pregnant women attending a primary health center found that only 20% of the participants were aware of hepatitis B and its health implications (Sanjay et al., 2021). These findings align with the results of this study in Abyei, highlighting the pervasive challenge of low awareness levels in resource-limited settings.

Interestingly, some studies in middle-income countries report varying levels of awareness that reflect regional and systemic differences in healthcare delivery. For instance, research conducted in China among pregnant women attending outpatient clinics showed a much higher awareness rate of 52.56% (Huang et al., 2023). This relatively higher level of awareness is attributed to China's active efforts to integrate health education into maternal and child health services. Likewise, a study conducted in Ghana among pregnant women using a cross-sectional facility-based survey revealed that 43.25% of the participants had excellent knowledge of the hepatitis B virus (Abdul-Wahab, Ziblim & Suara, 2021). These findings contrast sharply with the complete lack of awareness observed among pregnant women in Abyei.

Within sub-Saharan Africa, awareness levels of hepatitis B among pregnant women vary considerably across different countries and regions, reflecting the diversity of healthcare systems, educational initiatives, and cultural influences. For example,

studies conducted in Nigeria, Ghana, and Ethiopia have yielded mixed results. While some research indicates relatively higher awareness levels, others report significantly lower levels of awareness, similar to the findings in Abyei, South Sudan (Adewole et al., 2017; Ofori-Asenso & Agyeman, 2016). These variations underscore the complexity of addressing hepatitis B awareness in sub-Saharan Africa, where healthcare resources are often unevenly distributed, and cultural beliefs can pose barriers to effective health education.

The findings of this study align closely with a study conducted in the Democratic Republic of Congo, where only 6.8% of pregnant women attending antenatal care were aware of hepatitis B (Mudji, Madinga & Horsmans, 2021). Similarly, a study in Ethiopia revealed that 73.4% of pregnant women attending antenatal care had low levels of awareness about hepatitis B (Gebrecherkos et al., 2020). These figures are consistent with the findings from Abyei, where none of the participants had any knowledge of hepatitis B. Another study conducted in Nigeria showed that approximately half (52.6%) of pregnant women had good knowledge of hepatitis B, which stands in stark contrast to the complete lack of awareness reported in Abyei (Ade-Ojo et al., 2023). Additionally, a study in Ethiopia conducted among pregnant women attending tertiary hospitals revealed that 89.6% of the participants had poor knowledge of hepatitis B, further mirroring the findings from Abyei (Dagnew et al., 2020).

The lack of awareness observed in Abyei is further highlighted through qualitative data collected during this study. The qualitative analysis revealed a widespread and concerning absence of knowledge among pregnant women regarding hepatitis B. Participants consistently reported low levels of awareness, with some even suggesting that no prior studies or educational initiatives had been conducted on this issue in the

region. This observation is indicative of a systemic failure to prioritize hepatitis B as a public health concern in Abyei. The absence of awareness activities, community outreach programs, and educational campaigns further exacerbates the situation, leaving many pregnant women unaware of the risks associated with hepatitis B and the available preventive measures.

The implications of this lack of awareness are far-reaching. Without knowledge of hepatitis B, pregnant women are unlikely to seek screening or vaccination, both of which are critical in preventing the vertical transmission of the virus from mother to child. Hepatitis B can be transmitted during childbirth or through close contact after birth, making it essential to identify and manage cases during pregnancy. The absence of awareness also hampers efforts to reduce the stigma associated with the disease, which can deter individuals from seeking care and disclosing their status. In regions like Abyei, where healthcare resources are already limited, the added challenge of low awareness creates significant barriers to controlling the spread of hepatitis B.

To address these challenges, targeted interventions are urgently needed to raise awareness about hepatitis B among pregnant women in Abyei. Public health education campaigns tailored to the local context can play a pivotal role in disseminating information about the disease, its transmission routes, and available preventive measures. These campaigns should leverage community networks, religious institutions, and local leaders to ensure broad reach and cultural acceptance. Integrating hepatitis B education into antenatal care services is another critical step. Healthcare providers can serve as trusted sources of information, educating pregnant women during routine check-ups and encouraging them to undergo screening and vaccination.

Strengthening the healthcare system in Abyei is a fundamental step toward improving awareness and access to preventive services for hepatitis B. This region faces numerous challenges, including limited infrastructure, inadequate healthcare worker training, and an insufficient supply of diagnostic tools and vaccines. Addressing these systemic issues is crucial to creating an environment where public health interventions can effectively reduce the burden of hepatitis B. Investments in healthcare infrastructure are essential, particularly in rural and underserved areas where access to care is severely constrained. Establishing well-equipped healthcare facilities with functional diagnostic services ensures that individuals, especially pregnant women, can access timely and accurate testing.

Screening programs for hepatitis B must become an integral part of routine antenatal care services. Pregnant women represent a critical population for targeted interventions, as mother-to-child transmission (MTCT) is one of the primary routes of hepatitis B transmission in high-endemic regions like Abyei. Integrating hepatitis B screening into antenatal care ensures that all pregnant women are tested during their pregnancy. Early identification of hepatitis B-positive mothers allows healthcare providers to implement preventive measures, such as antiviral therapy or immunoglobulin treatment, reducing the risk of MTCT. This approach not only improves maternal and child health outcomes but also reduces the overall burden of chronic hepatitis B in future generations.

Vaccination campaigns targeting high-risk populations are another vital component of hepatitis B prevention efforts. In Abyei, these campaigns should prioritize pregnant women and their families, ensuring that those most vulnerable to transmission are protected. Administering the hepatitis B birth dose vaccine to newborns within 24 hours of delivery is critical for preventing chronic infection. Expanding vaccine

coverage requires addressing logistical barriers, such as vaccine shortages, inadequate cold chain systems, and limited healthcare staffing. Governments and international organizations must work collaboratively to ensure a reliable supply of vaccines and the resources necessary for their distribution.

Training healthcare workers is another key element in strengthening Abyei's healthcare system. Properly trained personnel are better equipped to provide comprehensive care, including conducting screenings, administering vaccinations, and offering counseling to hepatitis B-positive individuals. Training programs should focus on improving healthcare workers' knowledge of hepatitis B, including its transmission, prevention, and management. This ensures that frontline workers can deliver accurate information to patients and communities, fostering trust and encouraging positive health-seeking behaviors.

Beyond systemic improvements, addressing the cultural and social factors contributing to low awareness levels is critical. In Abyei, as in many other regions, misconceptions about hepatitis B hinder efforts to educate the population and promote preventive measures. Misunderstandings about the causes and consequences of hepatitis B can lead to fear, stigma, and discrimination, discouraging individuals from seeking care. Community engagement is essential to overcoming these barriers. Involving community leaders, religious figures, and traditional healers in hepatitis B education initiatives can help bridge the gap between healthcare providers and the community. These trusted figures can play a pivotal role in dispelling myths, promoting accurate information, and encouraging individuals to seek testing and vaccination.

Community engagement efforts should also focus on reducing the stigma associated with hepatitis B. Stigma not only affects those living with the disease but also impedes

broader public health initiatives by fostering secrecy and discouraging open dialogue. Public health campaigns should emphasize that hepatitis B is a preventable and manageable condition, highlighting the importance of early detection and vaccination. Creating a supportive environment where individuals feel empowered to access care without fear of discrimination is vital for improving health outcomes.

Raising awareness about hepatitis B requires comprehensive education campaigns tailored to the needs of the community. These campaigns should provide clear and culturally appropriate information about hepatitis B, including its transmission routes, risk factors, and prevention methods. Educational materials should be developed in local languages and distributed through various channels, including radio, community meetings, and healthcare facilities. Targeting both individuals and families ensures that the entire community understands the importance of hepatitis B prevention and is motivated to take action.

Education initiatives should also be integrated into existing healthcare services. For example, antenatal care visits present an ideal opportunity to educate pregnant women about hepatitis B and the steps they can take to protect themselves and their babies. Similarly, vaccination clinics can serve as platforms for raising awareness about the benefits of immunization and addressing any concerns or misconceptions that individuals may have. By embedding education efforts within routine healthcare interactions, providers can reach a wider audience and reinforce key messages about hepatitis B prevention.

In addition to raising awareness, it is important to address the broader systemic challenges that contribute to low awareness levels. Limited healthcare access, inadequate health education initiatives, and cultural barriers all play a role in

perpetuating the hepatitis B burden in Abyei. These challenges are not unique to Abyei; they are common in many low- and middle-income countries, where similar factors hinder public health efforts. However, the complete absence of awareness among pregnant women in Abyei underscores the urgent need for targeted interventions to address these issues.

Improving access to healthcare services is a critical step in bridging the gap between awareness and action. Many individuals in Abyei face significant barriers to accessing care, including long travel distances, high costs, and limited availability of services. Expanding the reach of healthcare facilities through mobile clinics and outreach programs can help bring essential services closer to underserved communities. These initiatives should prioritize high-risk populations, such as pregnant women, to ensure that those most in need receive timely and appropriate care.

Financial constraints are another significant barrier to healthcare access in Abyei. Many families cannot afford the costs associated with hepatitis B testing, treatment, or vaccination, limiting their ability to take preventive measures. Subsidizing these services or offering them free of charge can help reduce the financial burden on families and encourage greater participation in hepatitis B prevention programs. Governments and international organizations must prioritize funding for these initiatives to ensure their sustainability and effectiveness.

Collaboration between governments, non-governmental organizations, and international agencies is essential for addressing the systemic and cultural barriers to hepatitis B prevention in Abyei. These partnerships can provide the financial, technical, and logistical support needed to implement comprehensive public health programs. For example, donor funding can help address resource gaps, while technical assistance can

support the development of healthcare infrastructure and the training of healthcare providers. Coordinated efforts at the national and global levels are necessary to ensure that hepatitis B prevention remains a priority and that progress toward eliminating MTCT is sustained.

Monitoring and evaluation are critical for measuring the impact of hepatitis B prevention efforts and identifying areas for improvement. Regular data collection on awareness levels, vaccination coverage, and disease prevalence can provide valuable insights into the effectiveness of interventions and inform future strategies. Investing in research to better understand the local epidemiology of hepatitis B, including risk factors for transmission and barriers to care, can guide the development of targeted approaches to prevention and treatment in Abyei.

Integrating hepatitis B prevention into broader maternal and child health initiatives can maximize the impact of public health efforts. Combining hepatitis B screening and vaccination with other antenatal and postnatal services can streamline care delivery and ensure that women and children receive comprehensive support. This approach not only improves health outcomes for those at risk of hepatitis B but also strengthens the overall healthcare system by promoting efficiency and resource-sharing.

In conclusion, the findings of this study underscore a significant gap in awareness about hepatitis B among pregnant women in Abyei, South Sudan. This lack of awareness reflects broader systemic challenges, including limited healthcare access, inadequate health education initiatives, and cultural barriers. The complete absence of awareness in Abyei highlights the urgent need for targeted interventions to address this public health issue. By strengthening the healthcare system, integrating hepatitis B screening and vaccination into antenatal care, and engaging with the community, it is possible to

improve awareness and reduce the burden of hepatitis B in Abyei and other high-prevalence regions. Through a combination of systemic improvements, community engagement, and sustained investment in public health, Abyei can make significant progress in reducing the impact of hepatitis B and protecting the health of its most vulnerable populations.

Through these efforts, pregnant women in Abyei can be empowered with the knowledge and resources needed to protect themselves and their children from hepatitis B. These interventions will not only improve maternal and child health outcomes but also contribute to the broader goal of eliminating hepatitis B as a public health threat in high-burden regions worldwide.

4.12 Risk factors associated with viral hepatitis B

This study identifies several key factors significantly associated with hepatitis B (HBV) seroprevalence among pregnant women, including the age of first sexual experience, history of sexually transmitted infections (STIs), intravenous drug use, living with a husband infected with HBV, and cultural practices such as nose piercing. These findings are consistent with global research that highlights these risk factors as critical contributors to HBV transmission. Exploring these associations in detail provides valuable insights into the dynamics of hepatitis B transmission and underscores the importance of targeted public health interventions.

One of the significant findings of this study is the association between the age of first sexual activity and HBV seroprevalence. Early sexual debut has been widely recognized as a risk factor for HBV transmission due to increased exposure to unprotected sexual contact at a younger age. Globally, several studies corroborate this association. For instance, a study conducted in China revealed that early sexual debut,

defined as initiating sexual activity before the age of 20, was significantly associated with HBV infection among pregnant women (Shi et al., 2017). This increased risk is often attributed to a lack of knowledge about safe sexual practices and the increased likelihood of having multiple sexual partners over time.

Similar findings have been reported in sub-Saharan Africa, where early sexual initiation is prevalent due to cultural norms and socio-economic factors. A study conducted in Nigeria found that early sexual debut was associated with a heightened risk of HBV infection among pregnant women (Utoo et al., 2017). The Nigerian study aligns closely with the findings from Abyei, where early marriage and sexual activity contribute significantly to HBV transmission. Another study in Ethiopia that assessed HBV seroprevalence and associated risk factors among pregnant women found that having multiple sexual partners was a critical contributor to HBV infection (Firde et al., 2022). This evidence underscores the role of early sexual experiences and risky sexual behaviors in facilitating HBV transmission, particularly in high-endemic regions.

Early marriage, which often coincides with early sexual debut, further compounds the risk of HBV transmission. A study conducted in Nigeria among pregnant women attending antenatal clinics reported a higher prevalence of HBV among women who were married before the age of 18, reflecting similar trends observed in Abyei (Mustapha et al., 2020). Early marriage not only exposes women to sexual activity at a younger age but also limits their autonomy in making informed decisions about their sexual health, increasing their vulnerability to HBV infection.

Another significant factor identified in this study is the use of intravenous drugs, which is a well-documented risk factor for HBV transmission globally. Sharing contaminated needles and syringes provides a direct route for HBV transmission, making intravenous

drug use a critical public health concern. Studies conducted in various regions confirm this association. For example, research by Hutin et al. (1999) and Cullen et al. (2003) established that intravenous drug use significantly contributes to the spread of HBV among at-risk populations. While intravenous drug use is less prevalent in sub-Saharan Africa compared to other regions, studies still identify it as a risk factor for HBV transmission where drug use occurs. In South Africa, for instance, needle-sharing practices among drug users were found to be a major contributor to HBV transmission (Igumbor et al., 2014).

This study's findings align with global research that highlights intravenous drug use as a pathway for HBV transmission. The association underscores the need for harm reduction programs, including needle exchange services and public health campaigns targeting drug users. Such interventions can reduce the risk of HBV transmission among this population and the broader community.

The study also identifies living with a husband infected with HBV as a significant risk factor for seroprevalence among pregnant women. Close household contact with an HBV-positive individual increases the likelihood of exposure to the virus through bodily fluids or contaminated surfaces. Globally, research supports this finding. For instance, a study conducted in China found that living with an HBV-positive partner significantly heightened the risk of HBV transmission within households (Zhao et al., 2021). This increased risk is attributed to shared living spaces, frequent contact, and potential exposure to infected blood or other bodily fluids.

Similarly, a study conducted in Sierra Leone reported that pregnant women living with HBV-positive partners had a higher rate of HBV seropositivity (Ghazzawi et al., 2022). These findings emphasize the importance of family-based interventions, such as

vaccinating household members and providing education on safe practices to reduce the risk of intra-household HBV transmission.

Cultural practices, including nose piercing, emerged as another significant factor associated with HBV seroprevalence in this study. Body modification practices, such as nose and ear piercing, are common in many communities and often carry cultural or religious significance. However, when these procedures are performed using non-sterile equipment, they can facilitate the transmission of bloodborne pathogens, including HBV.

Research from other regions supports the association between piercing and HBV transmission. For example, a study conducted in India among pregnant women attending a tertiary care center found that piercings were associated with an increased risk of HBV infection (Singh et al., 2021). Similarly, research in Ethiopia revealed that nose piercing significantly contributed to HBV infection among pregnant women attending antenatal clinics (Umare et al., 2016). However, it is worth noting that not all studies agree on the role of piercings in HBV transmission. For instance, a study conducted in Uganda reported no significant association between body piercings and HBV positivity (Mugabiirwe et al., 2022). These discrepancies may be attributed to differences in piercing practices, hygiene standards, and the prevalence of HBV in various settings.

A history of sexually transmitted infections (STIs) was another risk factor strongly associated with HBV seroprevalence in this study. STIs and HBV share similar modes of transmission, primarily through unprotected sexual contact. Individuals with a history of STIs are more likely to engage in high-risk sexual behaviors, such as having

multiple partners or inconsistent condom use, which also increase the risk of HBV transmission.

Global research consistently highlights the link between STIs and HBV infection. For example, Terrault et al. (2018) reported that individuals with STIs, particularly those with high-risk sexual behaviors, are more likely to contract HBV. In sub-Saharan Africa, where the prevalence of both STIs and HBV is high, this association is particularly evident. Studies conducted in Ethiopia have found that a history of STIs is a predictor of HBV infection among pregnant women (Kampe et al., 2023). Similar findings were reported in Indonesia, where having a partner positive for HBV was associated with an increased risk of infection (Kartini & Syamsul, 2022). These findings emphasize the need for integrated sexual and reproductive health services that address both STIs and HBV.

The interplay between these risk factors highlights the complexity of HBV transmission dynamics. Addressing these factors requires a multifaceted approach that includes prevention, education, and targeted interventions. Public health campaigns should emphasize the importance of safe sexual practices, including the use of condoms and reducing the number of sexual partners. Community engagement is also critical for raising awareness about the risks associated with cultural practices like piercings and promoting the use of sterilized equipment.

Strengthening healthcare services is equally important. Ensuring that all pregnant women are screened for HBV during antenatal visits can facilitate early detection and intervention. Vaccinating infants born to HBV-positive mothers within 24 hours of birth is essential for preventing MTCT. Providing access to antiviral therapies for pregnant women with high viral loads can further reduce the risk of transmission.

Studies conducted in various countries have consistently reported an association between intravenous drug use and hepatitis B infection among pregnant women (Hutin et al., 1999; Cullen et al., 2003). In sub-Saharan Africa, while intravenous drug use may be less prevalent compared to other regions, studies have still identified it as a risk factor for hepatitis B transmission among pregnant women in settings where drug use occurs (Igumbor et al., 2014). Close household contact with individuals infected with hepatitis B increases the risk of transmission, especially through exposure to infected blood or body fluids. Studies conducted in various countries have shown that living with a hepatitis B-positive individual is a significant risk factor for hepatitis B infection among pregnant women (El-Ghitany et al., 2010; Mele et al., 2001). Similarly, in sub-Saharan Africa, household transmission is recognized as a common mode of hepatitis B transmission, and living with an infected person has been identified as a risk factor for infection (Nnaemeka et al., 2020). Nose and ear piercing, particularly in settings where sterile procedures are not followed, can pose a risk of hepatitis B transmission through contaminated needles or instruments.

Hepatitis B virus (HBV) transmission through cultural and behavioral practices, such as nose and ear piercing, remains an important area of investigation. While there are relatively few studies directly addressing the association between these practices and HBV transmission among pregnant women, broader research highlights the potential risks posed by unsafe piercing practices. These risks stem from the use of non-sterile equipment, which can facilitate the transmission of bloodborne pathogens, including HBV. A study by Hou et al. (2017) emphasized this association in general populations, suggesting that traditional practices involving skin penetration, including piercings, may contribute to the spread of the virus in resource-limited settings.

In sub-Saharan Africa, traditional cultural practices such as scarification, ritual tattooing, and other forms of body modification may also play a role in HBV transmission. These practices are often performed in non-clinical settings, where sterilization protocols may not be followed, creating opportunities for viral spread. For instance, Ojo et al. (2019) explored how these culturally significant practices might unintentionally contribute to the prevalence of HBV, particularly among women of reproductive age who are more likely to engage in certain cultural rites. The findings underline the importance of addressing such practices as part of comprehensive public health strategies aimed at reducing HBV transmission.

Regarding the piercing of noses and its relationship with HBV infection, this study aligns with findings from other regions. For example, a study conducted in India examining risk factors among pregnant women attending a tertiary care center found a significant association between piercings and an increased risk of HBV infection (Singh et al., 2021). Similarly, in Ethiopia, research among pregnant women attending antenatal care clinics revealed that nose piercing was significantly linked to HBV infection, likely due to the use of non-sterile piercing tools in informal settings (Umare et al., 2016). These studies reinforce the potential role of unsafe body modification practices in facilitating HBV transmission, particularly in areas where cultural practices involving piercing are prevalent.

However, there are conflicting findings in the literature regarding the association between piercings and HBV infection. A study conducted in Ethiopia among pregnant women attending public health facilities reported no significant link between nose piercings and HBV infection (Kampe et al., 2023). Similarly, research from Uganda did not find an association between body piercings and HBV positivity (Mugabiirwe et al., 2022). These discrepancies may be due to differences in study populations, cultural

contexts, and the prevalence of unsafe piercing practices in specific regions. Such variability underscores the need for further research to clarify the role of piercings and other cultural practices in HBV transmission and to identify region-specific risk factors.

In this study, logistic regression analysis identified sexually transmitted infections (STIs) and intravenous drug use as significant predictors of HBV infection among pregnant women in Abyei, South Sudan. The association between STIs and HBV infection is well-documented globally and aligns with findings from similar studies conducted in sub-Saharan Africa. STIs and HBV share overlapping modes of transmission, particularly through unprotected sexual contact. This shared route of transmission makes individuals with a history of STIs more vulnerable to HBV infection, highlighting the need for integrated approaches to sexual and reproductive health.

Globally, the relationship between STIs, including HIV and syphilis, and HBV infection has been extensively studied. Unprotected sexual intercourse with an infected partner is a major risk factor for HBV transmission. Terrault et al. (2018) reported that individuals with a history of STIs are more likely to contract HBV, due in part to risky sexual behaviors such as inconsistent condom use and having multiple sexual partners. These behaviors increase the likelihood of exposure to HBV and other sexually transmitted pathogens, particularly in high-prevalence regions.

In sub-Saharan Africa, where the burden of both STIs and HBV is high, this association is particularly relevant. For instance, studies in Ethiopia have identified a history of STIs as a significant predictor of HBV infection among pregnant women (Kampe et al., 2023). Similar findings have been reported in Indonesia, where having a partner who is HBV-positive was associated with a higher risk of infection (Kartini & Syamsul, 2022).

These findings emphasize the critical role of sexual transmission in HBV spread and the importance of integrating HBV prevention into broader sexual and reproductive health programs.

Comprehensive sexual and reproductive health services that address both STIs and HBV are essential for reducing the risk of transmission among vulnerable populations, including pregnant women. Such integrated approaches should include routine screening for both STIs and HBV during antenatal care visits, as well as education on safe sexual practices and the availability of preventive measures like vaccination. Combining these services within a single healthcare framework can improve access, enhance efficiency, and reduce the overall burden of disease.

Screening and prevention programs should target high-risk populations, ensuring that pregnant women and their partners are tested for both STIs and HBV. Early identification of infected individuals allows for timely intervention, such as the provision of antiviral therapy or hepatitis B immunoglobulin (HBIG) to prevent mother-to-child transmission. Integrating STI and HBV screening into antenatal care also provides an opportunity to educate women about the importance of preventive measures, including condom use and vaccination, in reducing transmission risks.

Education and community engagement are critical components of integrated sexual and reproductive health services. In many high-endemic regions, including Abyei, there is limited awareness about the relationship between STIs and HBV. Public health campaigns can help raise awareness about these connections and promote behaviors that reduce transmission risks. Engaging community leaders and healthcare providers in these efforts can enhance their reach and impact, ensuring that messages resonate with the target population.

In addition to sexual transmission, intravenous drug use emerged as a significant risk factor for HBV infection in this study. The use of contaminated needles and syringes is a well-established pathway for the transmission of bloodborne pathogens, including HBV. Globally, studies have consistently demonstrated the association between intravenous drug use and HBV infection. For example, research by Hutin et al. (1999) and Cullen et al. (2003) highlighted the role of needle-sharing practices in spreading HBV among drug users.

In sub-Saharan Africa, while intravenous drug use is less prevalent compared to other regions, it remains a risk factor for HBV transmission where it does occur. For instance, studies in South Africa have identified needle-sharing practices among drug users as a significant contributor to HBV spread (Igumbor et al., 2014). These findings underscore the need for harm reduction programs, such as needle exchange initiatives, that aim to reduce the transmission of HBV and other bloodborne pathogens among drug-using populations.

Addressing intravenous drug use as a risk factor for HBV transmission requires a multi-faceted approach that includes prevention, education, and access to healthcare services. Public health campaigns should focus on raising awareness about the risks associated with needle-sharing and promoting safe injection practices. Providing access to clean needles and syringes, as well as addiction treatment services, can help reduce HBV transmission among drug users and the broader community.

The findings of this study highlight the complex interplay of cultural, behavioral, and systemic factors in HBV transmission. Factors such as unsafe piercing practices, a history of STIs, and intravenous drug use all contribute to the high burden of HBV among pregnant women in Abyei. Addressing these risk factors requires a

comprehensive public health strategy that combines prevention, education, and healthcare access.

Studies have consistently demonstrated a strong association between sexually transmitted infections (STIs) and hepatitis B virus (HBV) infection, particularly among individuals engaging in high-risk sexual behaviors. In high-income countries, individuals with STIs are often at an increased risk of HBV infection due to factors such as having multiple sexual partners, inconsistent condom use, and participation in sex work. These behaviors heighten exposure to HBV, which is transmitted primarily through contact with infected bodily fluids (Sagnelli et al., 2018). This association underscores the critical need for integrated sexual health programs that address both STIs and HBV, as tackling these shared risk factors can significantly reduce disease transmission.

In sub-Saharan Africa, where both STIs and HBV are highly prevalent, the overlap between these conditions is particularly pronounced. Studies in this region have consistently reported a higher prevalence of HBV among individuals with a history of STIs, highlighting the dominant role of sexual transmission in the spread of HBV (Adewole et al., 2017; Ofori-Asenso & Agyeman, 2016). Limited access to sexual health services, inadequate STI treatment infrastructure, and cultural norms that discourage discussions about sexual health exacerbate the challenge of addressing these intertwined epidemics. Poulin et al. (2020) emphasized how these barriers contribute to the increased risk of HBV transmission in sub-Saharan Africa, pointing to the urgent need for culturally sensitive public health interventions.

The findings of this study align with these broader observations. A notable association between STIs and HBV infection was identified, corroborating evidence from Ethiopia

where Kampe et al. (2023) reported that a history of STIs among pregnant women was a significant predictor of HBV infection. These findings emphasize the role of integrated healthcare approaches that include routine screening and prevention strategies for both STIs and HBV. Similarly, research from Indonesia supports this study's conclusions, showing that having sexual partners who are HBV-positive is strongly associated with HBV incidence (Kartini & Syamsul, 2022). Such evidence highlights the importance of targeted education and behavioral interventions to promote safe sexual practices.

A meta-analysis and systematic review conducted by Aghaei et al. (2023) further reinforces the link between STIs and HBV infection. This study demonstrated that individuals with current or past STIs were significantly more likely to contract HBV. The findings suggest that the biological and behavioral overlap between STIs and HBV creates a shared vulnerability that must be addressed through integrated health services. This overlap is particularly relevant in high-burden regions like sub-Saharan Africa, where the co-occurrence of multiple infectious diseases often overwhelms healthcare systems and complicates disease management.

This study also reflects findings from research conducted in the Eastern Mediterranean region, which explored the prevalence of HBV among people who inject drugs. A systematic review and meta-analysis revealed that 2.66% of this population was infected with HBV, underscoring the risks associated with injecting drug use (Aghaei et al., 2023). The use of shared needles and syringes is a well-established route of HBV transmission, as contaminated injecting equipment directly introduces infected blood into the body. These findings highlight the importance of harm reduction programs, including needle exchange initiatives and safe injection education, to mitigate HBV transmission among drug users.

Further supporting this study's findings, research from Ethiopia examined HBV infection and associated risk factors among pregnant women attending public hospitals. The study reported that sharing sharp materials, such as razors or needles, significantly increased the risk of HBV infection (Tesfu, Habtemariam & Belay, 2023). This association points to the need for public health education campaigns to raise awareness about the dangers of sharing sharp objects and the importance of sterilization practices, particularly in communities where informal or cultural practices involving shared equipment are common.

Similarly, research conducted in Pakistan identified surgical procedures and injections as major risk factors for HBV transmission among pregnant women (Naseeb, Dehar & Rashid, 2023). The study highlighted the role of unsafe medical practices in spreading HBV, particularly in low-resource settings where access to sterile medical equipment and trained personnel may be limited. These findings mirror this study's results, emphasizing the need to strengthen healthcare infrastructure to ensure safe medical practices and reduce HBV transmission.

However, not all studies have consistently supported these associations. For instance, a study conducted in Iraq investigating risk factors for HBV infection among pregnant women reported that a history of drug injection was not associated with HBV infection (Khalid et al., 2022). This discrepancy may stem from differences in the prevalence of injecting drug use, cultural norms, or healthcare practices between regions. Such variations underscore the importance of context-specific research to inform effective public health strategies.

This study also identified living with a partner infected with HBV as a significant risk factor for HBV infection, a finding corroborated by research from multiple settings. A

study conducted in China found that living with an HBV-positive partner significantly increased the risk of HBV transmission within households (Zhao et al., 2021). This risk is attributed to the close contact and shared living environment, which increase opportunities for exposure to infected bodily fluids. Household transmission of HBV is a well-recognized phenomenon, particularly in regions with high disease prevalence.

Similar findings were reported in Sierra Leone, where Ghazzawi et al. (2022) investigated factors associated with HBV seropositivity among pregnant women. The study revealed that living with a partner who is HBV-positive was strongly linked to HBV infection. These findings highlight the need for family-based interventions to reduce intra-household transmission, such as vaccinating all household members and educating families about HBV prevention.

The association between cultural practices and HBV transmission also emerged as a notable theme in this study. Practices such as sharing sharp materials for traditional or cosmetic purposes, including scarification and nose piercing, can facilitate the spread of HBV when proper sterilization procedures are not followed. Research from India demonstrated a significant link between piercing and HBV infection among pregnant women, reflecting similar findings in this study (Singh et al., 2021). In Ethiopia, Umare et al. (2016) also found that nose piercing was associated with an increased risk of HBV infection, particularly in settings where piercings were performed informally using non-sterile equipment.

Conversely, some studies did not identify a significant association between body piercing and HBV infection. For example, research from Uganda reported no link between piercings and HBV positivity (Mugabiirwe et al., 2022). Similarly, a study conducted in Ethiopia among pregnant women attending public health facilities found

no association between nose piercings and HBV infection (Kampe et al., 2023). These mixed findings suggest that the risk associated with piercing practices may vary depending on the prevalence of HBV in a given population and the safety standards observed during piercing procedures.

The discrepancies in findings across studies highlight the need for further research to clarify the role of cultural practices in HBV transmission. Public health efforts should focus on raising awareness about the risks associated with unsafe piercing and promoting the use of sterilized equipment. Community engagement is essential in these efforts, as cultural norms and practices are deeply embedded and require sensitive and inclusive approaches to drive behavior change.

The findings of this study, combined with evidence from global and regional research, emphasize the need for integrated approaches to HBV prevention and control. Addressing the shared risk factors for STIs and HBV through comprehensive sexual and reproductive health services can significantly reduce disease transmission. Screening programs for both STIs and HBV should be implemented as part of routine antenatal care, ensuring that pregnant women and their partners are tested and provided with appropriate counseling and treatment.

Education and community engagement are critical components of these integrated services. Public health campaigns should focus on promoting safe sexual practices, such as consistent condom use, reducing the number of sexual partners, and regular testing for STIs and HBV. Engaging community leaders and healthcare providers in these efforts can enhance their impact and ensure that messages resonate with the target population.

Strengthening healthcare systems is also essential for addressing systemic barriers to HBV prevention. Ensuring the availability of safe medical practices, including sterilized equipment for surgeries and injections, can reduce the risk of iatrogenic transmission. Investments in healthcare infrastructure, training for healthcare workers, and the availability of diagnostic tools and vaccines are critical to creating an environment where individuals can access comprehensive care.From the qualitative analysis, several factors were identified as potential risks for hepatitis B infection among pregnant women. Unskilled delivery practices, low attendance at antenatal care, multiple sexual partners, wife inheritance, non-hygienic practices like piercing, and gender-based violence were highlighted as contributors to the spread of hepatitis B. These findings emphasize the urgent need for targeted interventions to address these specific risk factors. Qualitative data also revealed identified multiple barriers and challenges that hinder the prevention of hepatitis B among pregnant women in Abyei. Lack of screening services, absence of prophylactic services for infants, limited awareness activities, low socio-economic status, absence of linkages to treatment services, and cultural beliefs were highlighted. Furthermore, the collapsed health system and inadequate supply chain contribute to the challenges faced in the prevention of hepatitis B. Addressing these barriers is crucial to developing effective prevention strategies.

4.13 Barriers and challenges in viral hepatitis B prevention

The prevention of viral hepatitis B among pregnant women in Abyei, South Sudan, faces multifaceted challenges rooted in systemic shortcomings and societal barriers. These obstacles not only undermine the efficacy of intervention strategies but also place both mothers and their unborn children at an elevated risk of infection and its associated complications. A critical gap in the healthcare system lies in the lack of

screening services tailored to pregnant women. Screening is an essential step in identifying carriers of the hepatitis B virus (HBV) during pregnancy, enabling timely and targeted interventions to prevent mother-to-child transmission (MTCT). Without accessible and reliable screening services, many women are left unaware of their HBV status, losing the opportunity for early detection and subsequent care. This issue is compounded by the absence of prophylactic services for infants born to HBV-positive mothers. Administering hepatitis B immunoglobulin (HBIG) and the hepatitis B vaccine within the first 24 hours after birth is highly effective in preventing vertical transmission, yet these life-saving measures are largely unavailable in Abyei. The lack of such services exposes newborns to a significant risk of chronic HBV infection, which can lead to long-term complications such as liver cirrhosis and hepatocellular carcinoma.

This challenge is not unique to Abyei; it mirrors broader trends observed in resource-limited settings globally. Across sub-Saharan Africa, inadequate healthcare infrastructure exacerbates the problem. Rural and underserved areas are particularly affected by the lack of facilities equipped to provide hepatitis B screening and treatment. These systemic deficiencies leave many women without access to necessary services, creating a significant gap in the prevention and control of HBV. Compounding these challenges is the low level of awareness about hepatitis B among pregnant women and the broader community. Many individuals in high-burden regions lack basic knowledge about the disease, its modes of transmission, and available preventive measures. Public health education campaigns, which are crucial for raising awareness, remain limited or absent in many parts of sub-Saharan Africa, including Abyei. Without adequate information, pregnant women are less likely to seek out

testing or vaccination, perpetuating a cycle of undiagnosed cases and untreated infections.

Globally, insufficient health education has been identified as a common barrier to the prevention and control of hepatitis B. This issue is particularly acute in sub-Saharan Africa, where studies consistently document widespread ignorance about the disease among both pregnant women and healthcare providers. In such contexts, the lack of awareness hinders efforts to promote maternal screening and infant vaccination, both of which are cornerstone strategies for preventing MTCT. Public health education campaigns are essential for addressing this gap, as they can help dispel myths and misconceptions about hepatitis B and encourage individuals to seek preventive care.

The challenges in Abyei extend beyond a lack of screening and awareness. Systemic barriers such as inadequate healthcare infrastructure, insufficient funding, and limited workforce capacity further undermine efforts to prevent hepatitis B. The healthcare system in Abyei struggles to meet the needs of its population due to a lack of trained personnel and resources. Many healthcare workers are not adequately trained to identify and manage HBV cases, particularly among pregnant women. This lack of expertise affects the quality of care provided and contributes to missed opportunities for early diagnosis and intervention. Additionally, the absence of a reliable supply chain for medical supplies, including HBV vaccines and HBIG, hampers efforts to deliver consistent and effective care.

Logistical challenges also play a significant role in limiting access to hepatitis B prevention services. Many pregnant women in Abyei live in remote areas where healthcare facilities are few and far between. Long travel distances, poor road infrastructure, and high transportation costs make it difficult for these women to access

screening and treatment services. Even when facilities are within reach, the high cost of healthcare can deter women from seeking care. Out-of-pocket expenses for screening, vaccination, and treatment place a significant financial burden on low-income families, further limiting access to essential services.

Cultural and social factors further compound the challenges of preventing hepatitis B in Abyei. Misconceptions about the disease and its transmission are widespread, fueled by a lack of education and awareness. For instance, some individuals may mistakenly believe that hepatitis B is caused by supernatural forces or view it as a condition associated with moral failings. These misconceptions can lead to stigma and discrimination against those living with HBV, discouraging individuals from disclosing their status or seeking care. Stigma not only affects those directly impacted by the disease but also undermines broader public health efforts by creating an environment of fear and secrecy.

Engaging communities is essential for addressing these cultural and social barriers. Involving local leaders, religious figures, and traditional healers in hepatitis B education campaigns can help dispel myths and promote accurate information about the disease. These trusted figures can play a pivotal role in encouraging individuals to seek screening and vaccination services. Community engagement efforts should also focus on reducing stigma and creating a supportive environment where individuals feel empowered to access care without fear of discrimination.

To address the challenges outlined above, a multi-faceted approach is needed. Strengthening the healthcare system in Abyei is a critical first step. Investments in healthcare infrastructure, training for healthcare workers, and the availability of diagnostic tools and vaccines are essential for creating an environment where

awareness can translate into action. Establishing well-equipped healthcare facilities in rural and underserved areas can improve access to screening and treatment services, particularly for pregnant women. Mobile clinics and outreach programs can also play a vital role in reaching remote communities and providing on-the-spot testing and vaccination.

Integrating hepatitis B screening and vaccination into routine antenatal care is another key strategy for preventing MTCT. Pregnant women represent a high-risk population that regularly interacts with healthcare services, making antenatal care an ideal platform for hepatitis B prevention efforts. Screening all pregnant women for HBV during their prenatal visits ensures early detection and enables timely interventions, such as the administration of antiviral therapy or HBIG. Providing the hepatitis B vaccine to newborns within the first 24 hours of birth is critical for preventing vertical transmission and reducing the risk of chronic infection.

Public health education campaigns should be a central component of hepatitis B prevention efforts in Abyei. These campaigns should aim to raise awareness about the disease, its transmission, and the importance of screening and vaccination. Educational materials should be culturally appropriate and delivered in local languages to ensure that they resonate with the target audience. Using various communication channels, such as community meetings, radio programs, and social media, can help reach a wider audience and reinforce key messages. Engaging community members in the design and implementation of these campaigns can also enhance their effectiveness and ensure that they address the specific needs and concerns of the population.

Addressing financial barriers to hepatitis B prevention is also critical. Subsidizing the cost of screening, vaccination, and treatment can help reduce the financial burden on

low-income families and increase access to essential services. Governments and international organizations must collaborate to secure funding for these initiatives and ensure their sustainability. Additionally, policies that prioritize free or low-cost healthcare services for vulnerable populations, including pregnant women, can play a significant role in improving access to care.

Collaboration between governments, non-governmental organizations, and international agencies is essential for addressing the systemic and cultural barriers to hepatitis B prevention in Abyei. These partnerships can provide the financial, technical, and logistical support needed to implement comprehensive public health programs. Donor funding can help address resource gaps, while technical assistance can support the development of healthcare infrastructure and the training of healthcare providers. Coordinated efforts at the national and global levels are necessary to ensure that hepatitis B prevention remains a priority and that progress toward eliminating MTCT is sustained.

Monitoring and evaluation are crucial for measuring the impact of hepatitis B prevention efforts and identifying areas for improvement. Regular data collection on awareness levels, vaccination coverage, and disease prevalence can provide valuable insights into the effectiveness of interventions and inform future strategies. Investing in research to better understand the local epidemiology of hepatitis B, including risk factors for transmission and barriers to care, can guide the development of targeted approaches to prevention and treatment in Abyei.

The prevention of viral hepatitis B among pregnant women in Abyei, South Sudan, is hindered by systemic shortcomings and societal barriers. The lack of tailored screening services, insufficient healthcare infrastructure, low levels of awareness, and cultural

stigmas all contribute to the high burden of HBV in this region. Addressing these challenges requires a comprehensive and multi-faceted approach that combines investments in healthcare infrastructure, public health education, and community engagement. By strengthening the healthcare system, integrating hepatitis B screening and vaccination into antenatal care, and reducing financial and cultural barriers, it is possible to improve maternal and child health outcomes and reduce the burden of hepatitis B in Abyei. Through sustained efforts and collaboration, significant progress can be made in combating this preventable disease and safeguarding the health of future generations.

The absence of linkages to treatment services presents another significant barrier. Pregnant women may be hesitant to undergo screening if they perceive no treatment options are available or accessible. This perpetuates the cycle of undiagnosed cases, as individuals who test positive may not see the benefit of knowing their status. Additionally, healthcare workers in Abyei often lack the necessary training and resources to manage hepatitis B prevention and treatment effectively. Inadequate training among healthcare providers limits their ability to offer comprehensive care and counseling to women at risk of HBV. This situation is further complicated by cultural beliefs and practices that contribute to stigma and discrimination against those living with hepatitis B. Misconceptions about the virus, its transmission, and its treatment often lead to social isolation, discouraging individuals from seeking medical care. In some communities, hepatitis B is viewed through a lens of moral judgment, creating additional barriers for those affected.

Sub-Saharan Africa is characterized by diverse cultural norms, many of which influence perceptions of hepatitis B. Studies have documented cultural taboos surrounding discussions of sexually transmitted infections, including hepatitis B, due to

fear of stigma and ostracism. These cultural barriers hinder efforts to promote screening and vaccination programs. In some cases, women may be reluctant to disclose their HBV status or seek medical care, fearing social repercussions. Addressing these misconceptions is critical for fostering trust and encouraging community engagement in prevention programs. Financial constraints also play a significant role in limiting access to hepatitis B prevention services in Abyei. The high cost of healthcare, including screening, vaccination, and treatment, places these essential interventions out of reach for many women, particularly those living in poverty. Out-of-pocket expenses are a common burden in low-resource settings, further deterring individuals from accessing care. Even when vaccines are available, their cost often makes them inaccessible to low-income families. This financial barrier is compounded by the lack of funding for public health programs, which restricts vaccination coverage in regions like Abyei.

The prevention of hepatitis B in Abyei, South Sudan, is fraught with logistical, systemic, and societal challenges that collectively undermine efforts to control the disease. One of the most pressing logistical barriers is the inadequacy of cold chain facilities, which are critical for the effective storage and transportation of vaccines. In many remote areas, the lack of reliable cold chain infrastructure prevents vaccines from being delivered in optimal condition, severely limiting access to those who need them most. This gap in the supply chain disproportionately affects marginalized communities, where hepatitis B prevalence is often highest. Without functional cold chain systems, the effectiveness of vaccination programs is compromised, leaving vulnerable populations at greater risk of infection.

The financial and logistical hurdles in Abyei are compounded by a collapsed healthcare system. Supply chain inefficiencies, outdated infrastructure, and the lack of essential medical resources hinder the delivery of vital healthcare services, including hepatitis B

screening, vaccination, and treatment. The absence of a robust healthcare system leaves many pregnant women unable to access the care they need to protect themselves and their newborns from hepatitis B. Addressing these systemic inadequacies is critical to preventing the spread of the virus and ensuring that high-risk populations receive appropriate interventions.

Trained healthcare workers play an essential role in the fight against hepatitis B. These professionals are responsible for administering vaccines, conducting screenings, and providing treatment and counseling to affected individuals. However, the healthcare system in Abyei suffers from a severe shortage of trained personnel. Many healthcare workers in the region lack the knowledge and skills necessary to implement effective hepatitis B prevention programs. This shortage further limits the capacity of the healthcare system to address the needs of pregnant women at risk of hepatitis B and exacerbates the challenges of delivering high-quality care.

The barriers to hepatitis B prevention in Abyei are deeply rooted in systemic inequities, cultural beliefs, and financial constraints. These challenges not only hinder the delivery of healthcare services but also perpetuate the disease burden in the region. Addressing these issues requires a comprehensive and multi-faceted approach that targets both structural and societal factors.

Expanding access to hepatitis B screening services for pregnant women is a critical first step in combating the disease. Screening programs should be integrated into routine antenatal care, ensuring that all pregnant women are tested for HBV as part of standard maternal health services. Early detection of HBV among pregnant women is essential for implementing timely interventions, such as administering antiviral therapies or hepatitis B immunoglobulin (HBIG) to prevent mother-to-child transmission (MTCT).

Integrating screening into existing maternal health programs allows healthcare providers to identify at-risk women during their routine visits, streamlining care delivery and reducing the burden of undiagnosed cases.

Reaching women in remote and underserved areas poses a significant challenge, but innovative solutions such as mobile clinics and outreach programs can bridge the gap in access to care. Mobile clinics equipped with diagnostic tools and staffed by trained personnel can bring essential services directly to communities that lack healthcare infrastructure. These clinics can provide on-the-spot screening, vaccination, and counseling, ensuring that even the most isolated populations receive the care they need. Outreach programs that leverage community health workers can further extend the reach of healthcare services, particularly in areas where traditional healthcare facilities are inaccessible.

Prophylactic services for infants born to HBV-positive mothers should be prioritized to prevent vertical transmission, which is one of the most common routes of hepatitis B infection in high-endemic areas like Abyei. Administering the hepatitis B birth dose vaccine within 24 hours of birth, followed by subsequent doses according to the national immunization schedule, is highly effective in preventing chronic HBV infection in newborns. For infants born to HBV-positive mothers, the addition of HBIG to the vaccination protocol significantly enhances protection against MTCT. Ensuring the availability of these prophylactic measures in healthcare facilities is critical for reducing the long-term burden of hepatitis B.

However, the availability of hepatitis B vaccines and immunoglobulin in Abyei remains a major challenge due to systemic inadequacies in the healthcare supply chain. Governments and international organizations must allocate resources to address these

gaps, particularly in high-burden areas. Investments in cold chain infrastructure are essential to ensure that vaccines remain effective throughout transportation and storage. Expanding the capacity of healthcare facilities to stock and distribute vaccines reliably can help overcome logistical barriers and increase vaccination coverage in remote and underserved regions.

Financial constraints also pose significant barriers to accessing hepatitis B prevention services in Abyei. Many families cannot afford the cost of screening, vaccination, or treatment, placing these essential services out of reach for large segments of the population. To address this issue, governments and international donors must provide funding to subsidize or eliminate out-of-pocket costs for hepatitis B services. Offering free or low-cost screening and vaccination programs can significantly increase uptake and ensure that financial barriers do not prevent individuals from accessing care.

Cultural beliefs and societal factors further complicate efforts to prevent hepatitis B in Abyei. Misconceptions about the disease, its transmission, and its consequences are widespread, often fueled by a lack of education and awareness. Many individuals in the region may not recognize the importance of screening and vaccination or may believe that hepatitis B is caused by supernatural forces or immoral behavior. These misconceptions contribute to stigma and discrimination against those living with hepatitis B, creating an environment of fear and reluctance to seek care.

Addressing these cultural and societal barriers requires community engagement and education. Involving local leaders, religious figures, and traditional healers in hepatitis B prevention efforts can help dispel myths and promote accurate information about the disease. These trusted figures can serve as advocates for health education, encouraging community members to participate in screening and vaccination programs. Public

health campaigns that use culturally appropriate messaging and local languages can further enhance the effectiveness of these efforts, ensuring that key messages resonate with the target audience.

Reducing stigma and discrimination is also critical for creating a supportive environment where individuals feel empowered to access care. Public health campaigns should emphasize that hepatitis B is a preventable and manageable condition, highlighting the importance of early detection and treatment. Normalizing conversations about hepatitis B can help reduce the social isolation experienced by those affected and encourage more people to seek testing and preventive measures.

Training healthcare workers is another essential component of addressing the barriers to hepatitis B prevention in Abyei. Providing comprehensive training on hepatitis B prevention, diagnosis, and treatment equips healthcare workers with the knowledge and skills they need to deliver high-quality care. Training programs should also focus on improving healthcare workers' ability to communicate effectively with patients, addressing cultural sensitivities, and promoting health education. Building a skilled and compassionate healthcare workforce is critical for overcoming systemic barriers and improving access to hepatitis B services.

Collaboration between governments, non-governmental organizations, and international agencies is vital for addressing the systemic and societal barriers to hepatitis B prevention in Abyei. These partnerships can provide the financial, technical, and logistical support needed to implement comprehensive public health programs. For example, donor funding can help address resource gaps in the healthcare system, while technical assistance can support the development of cold chain infrastructure and the

training of healthcare workers. Coordinated efforts can ensure that hepatitis B prevention remains a priority and that progress toward eliminating MTCT is sustained.

Monitoring and evaluation are crucial for measuring the impact of hepatitis B prevention efforts and identifying areas for improvement. Regular data collection on vaccination coverage, screening rates, and disease prevalence can provide valuable insights into the effectiveness of interventions and inform future strategies. Investing in research to better understand the local epidemiology of hepatitis B, including risk factors for transmission and barriers to care, can guide the development of targeted approaches to prevention and treatment.

The prevention of hepatitis B in Abyei, South Sudan, faces significant challenges rooted in logistical, systemic, and societal barriers. Inadequate cold chain facilities, a collapsed healthcare system, and cultural misconceptions all contribute to the persistence of the disease in this high-burden region. Addressing these challenges requires a multi-faceted approach that combines investments in healthcare infrastructure, community engagement, and financial support. By expanding access to screening and vaccination services, prioritizing prophylactic measures for infants, and reducing stigma and discrimination, it is possible to improve maternal and child health outcomes and reduce the burden of hepatitis B in Abyei. Through sustained collaboration and targeted interventions, significant progress can be made in combating this preventable disease and protecting the health of vulnerable populations.

Comprehensive health education campaigns are needed to raise awareness about hepatitis B among pregnant women and the broader community. These campaigns should emphasize the importance of screening, vaccination, and early intervention. Engaging community leaders and leveraging local communication channels can help

ensure that these messages reach a wide audience. Investments in healthcare infrastructure are critical for improving the delivery of hepatitis B prevention and treatment services. This includes training healthcare workers, improving supply chains, and expanding access to vaccines and diagnostic tools. Strengthening the healthcare system in Abyei will have a ripple effect, benefiting not only hepatitis B prevention efforts but also other maternal and child health initiatives. Community engagement is essential for addressing cultural beliefs and misconceptions about hepatitis B. Programs should involve local leaders, traditional healers, and religious figures to build trust and promote acceptance of preventive measures. Efforts to reduce stigma and discrimination are vital for encouraging individuals to seek care and disclose their HBV status.

Subsidizing the cost of hepatitis B vaccines and related healthcare services can help make these interventions more accessible to low-income families. Governments and non-governmental organizations must work together to ensure that financial constraints do not prevent pregnant women from accessing essential care. The barriers to hepatitis B prevention in Abyei are multifaceted and deeply entrenched. Overcoming these challenges requires a coordinated effort that integrates screening, vaccination, and treatment services into maternal healthcare programs. Raising awareness, strengthening healthcare systems, and addressing socio-economic and cultural barriers are critical steps toward reducing the burden of hepatitis B in this region. By implementing these strategies, it is possible to improve maternal and child health outcomes and make significant progress in the fight against hepatitis B in Abyei and other resource-limited settings.

4.14 Effectiveness of Hepatitis B vaccine in preventing mother-to-child transmission

The study conducted in Abyei, South Sudan, evaluated the effectiveness of the Hepatitis B (HBV) vaccine in preventing mother-to-child transmission (MTCT) among pregnant women attending antenatal clinics. The results revealed that of the 47 children born to HBV-positive mothers who received the vaccine, 2 children, representing 4.26% of the cohort, tested positive for Hepatitis B. These findings underscore the importance of implementing comprehensive and multi-layered vaccination strategies that go beyond the administration of the HBV vaccine alone. The study highlights the critical need to integrate additional preventive measures, such as the administration of Hepatitis B Immunoglobulin (HBIG) and the zero-dose vaccine, to enhance the efficacy of MTCT prevention efforts.

The HBV vaccine alone offers significant protection against MTCT, but the inclusion of HBIG and the zero-dose vaccine provides an additional layer of defense. This integrated vaccination approach is vital for minimizing the burden of Hepatitis B transmission from mothers to their infants. According to the World Health Organization (WHO, 2022), strategies combining these interventions are essential for achieving higher levels of effectiveness in MTCT prevention. The administration of HBIG within 24 hours of birth, alongside the initial dose of the HBV vaccine, neutralizes any virus acquired during childbirth, while the zero-dose vaccine strengthens the infant's immune response. Together, these measures offer a more robust prevention strategy that has been shown to significantly reduce MTCT rates.

In a study conducted in the United States, Schillie et al. (2018) demonstrated the success of this combined vaccination strategy, reporting minimal MTCT rates among

infants born to HBV-positive mothers who received HBIG, the HBV vaccine, and the zero-dose vaccine. This highlights the effectiveness of integrated approaches in achieving near-elimination of MTCT when implemented correctly. However, such success has not been uniformly replicated across different settings. Variations in MTCT outcomes are evident in studies from resource-limited settings, such as Ethiopia, where researchers like Desalegn et al. (2020) and Kampe et al. (2023) reported inconsistent results despite vaccination efforts. Contributing factors such as incomplete vaccination coverage, delays in the initiation of vaccination, and limited access to additional preventive measures like HBIG were identified as significant barriers to achieving optimal outcomes.

In Ethiopia, Desalegn et al. (2020) observed that many infants born to HBV-positive mothers did not receive the full vaccination schedule due to logistical challenges, including vaccine shortages and inadequate healthcare infrastructure. These gaps in service delivery often result in missed opportunities for effective intervention, leaving infants vulnerable to HBV infection. Similarly, Kampe et al. (2023) found that delays in administering the birth dose vaccine and HBIG were common in rural areas, where healthcare facilities were under-resourced and healthcare workers lacked training in HBV prevention protocols. These delays critically reduce the effectiveness of the vaccine and increase the risk of MTCT.

The findings in Abyei are consistent with these challenges observed in other resource-limited settings. The presence of a 4.26% MTCT rate, despite vaccination, highlights the gaps in the current approach to HBV prevention in the region. These results emphasize the need for comprehensive health systems strengthening to ensure the timely and effective administration of preventive measures. Addressing barriers such as

vaccine accessibility, healthcare infrastructure, and awareness among healthcare providers and the community is critical to improving outcomes.

Global studies provide further insight into the factors influencing the effectiveness of HBV vaccination in preventing MTCT. Research in high-income countries, where healthcare systems are well-resourced, consistently demonstrates high success rates in reducing MTCT through combined vaccination strategies. For example, in China, Zhang et al. (2022) reported that 0% of children born to HBV-negative mothers contracted the virus when vaccinated with the HBV vaccine alone or in combination with HBIG. Another study in China found that the transmission rate among infants born to HBV-positive mothers was as low as 1.9% when comprehensive preventive measures were employed (Yonghao et al., 2022). These findings underscore the potential for near-elimination of MTCT when integrated strategies are implemented effectively.

The discrepancy in outcomes between high-income and resource-limited settings highlights the influence of systemic barriers. In high-income countries, robust healthcare systems ensure consistent vaccine availability, timely administration, and adequate follow-up care. By contrast, in low-income regions such as Abyei, systemic challenges such as limited healthcare access, insufficient funding, and logistical constraints hinder the effective implementation of HBV prevention programs. These barriers often result in delays, incomplete vaccination schedules, and missed opportunities for intervention, undermining the success of vaccination efforts.

The importance of timely vaccination cannot be overstated. The birth dose vaccine is most effective when administered within 24 hours of delivery, as it prevents the virus from establishing an infection in the newborn. Delays in vaccination, even by a few

days, can significantly reduce its efficacy. This critical window of opportunity is often missed in resource-limited settings due to logistical issues, such as the unavailability of vaccines or healthcare workers at the time of delivery. Ensuring that vaccines are readily available and that healthcare providers are trained to administer them promptly is essential for improving outcomes.

Access to HBIG is another crucial factor in preventing MTCT, particularly for infants born to mothers with high HBV viral loads. HBIG provides immediate passive immunity by neutralizing the virus, offering protection until the infant's immune system can respond to the vaccine. However, in regions like Abyei, HBIG is often unavailable due to high costs, limited supply chains, and inadequate cold storage facilities. Addressing these challenges requires significant investments in healthcare infrastructure and supply chain management to ensure that HBIG is accessible to all infants at risk.

The success of HBV prevention programs also depends on community awareness and education. Many mothers in high-prevalence regions like Abyei are unaware of the importance of HBV vaccination and the availability of preventive measures. Public health education campaigns are critical for raising awareness and encouraging pregnant women to seek antenatal care and ensure their newborns receive the necessary vaccinations. Engaging community leaders, religious figures, and traditional healers in these efforts can help overcome cultural barriers and promote the uptake of preventive services.

Integrated healthcare approaches that combine HBV vaccination with other maternal and child health services can enhance the reach and effectiveness of prevention programs. For example, incorporating HBV screening and vaccination into routine

antenatal care ensures that pregnant women are tested for HBV and that those who test positive receive appropriate counseling and interventions. Providing HBV education during antenatal visits can also help dispel myths and misconceptions about the disease, empowering mothers to protect their children from infection.

Addressing the systemic challenges in Abyei requires collaboration between governments, non-governmental organizations, and international agencies. These partnerships can provide the financial, technical, and logistical support needed to strengthen healthcare systems and ensure the sustainability of HBV prevention programs. Investments in cold chain infrastructure, healthcare worker training, and vaccine procurement are essential for overcoming logistical barriers and ensuring the consistent availability of vaccines and HBIG.

Monitoring and evaluation are also critical for assessing the effectiveness of HBV prevention programs and identifying areas for improvement. Regular data collection on vaccination coverage, MTCT rates, and healthcare service delivery can provide valuable insights into program performance and guide future interventions. Investing in research to better understand the local epidemiology of HBV, including risk factors for transmission and barriers to care, can inform targeted approaches to prevention and treatment.

The study conducted in Abyei underscores the importance of comprehensive vaccination strategies in preventing MTCT of HBV. While the HBV vaccine alone provides significant protection, the inclusion of additional preventive measures such as HBIG and the zero-dose vaccine is essential for achieving optimal outcomes. The findings highlight the need to address systemic barriers, including vaccine accessibility, healthcare infrastructure, and community awareness, to improve the effectiveness of

HBV prevention programs in resource-limited settings. By adopting integrated approaches, strengthening healthcare systems, and fostering collaboration among stakeholders, it is possible to reduce the burden of hepatitis B and protect future generations from its devastating impacts.

The challenges identified in Abyei are consistent with findings from studies conducted globally and within sub-Saharan Africa. These emphasize the necessity of adopting integrated approaches to Hepatitis B prevention that address not only vaccination strategies but also barriers to access, timeliness of administration, and healthcare infrastructure. On a global scale, the efficacy of the HBV vaccine in preventing MTCT has been extensively documented. However, its effectiveness is influenced by several factors, including maternal viral load, timing and completeness of vaccination, and the availability of supplementary preventive measures such as HBIG. Studies conducted in high-income countries with robust vaccination programs demonstrate remarkable success rates in MTCT prevention. For example, research in the United States showed that the vaccination of infants born to HBV-positive mothers, when combined with HBIG and the zero-dose vaccine, resulted in negligible rates of MTCT (Schillie et al., 2018). These findings underscore the impact of well-resourced and well-structured healthcare systems in ensuring effective prevention of Hepatitis B transmission.

In contrast, the situation in sub-Saharan Africa, where Hepatitis B is endemic and healthcare access is often limited, presents unique challenges. Despite the documented effectiveness of the HBV vaccine, several barriers hinder its full potential in preventing MTCT. Issues such as incomplete vaccination schedules, late initiation of vaccination, and lack of access to HBIG and the zero-dose vaccine contribute to suboptimal outcomes in the region. Studies in Ghana, Nigeria, and Ethiopia have reported varying rates of MTCT despite efforts to implement vaccination programs. In Ghana, for

instance, Donkor et al. (2018) identified a lack of access to HBIG and delays in vaccination initiation as key barriers to effective MTCT prevention. Similarly, research in Nigeria by Utoo et al. (2017) highlighted the challenges of incomplete vaccination coverage and limited healthcare resources. In Ethiopia, studies by Desalegn et al. (2020) emphasized the importance of timely vaccination in reducing transmission rates, noting that late administration significantly compromises effectiveness.

Studies on the effectiveness of the HBV vaccine in preventing mother-to-child transmission (MTCT) reveal a wide range of outcomes, often influenced by variations in vaccination protocols, maternal health status, and healthcare infrastructure. Research conducted in China exemplifies this variability. Zhang et al. (2022) reported that no children born to HBV-negative mothers developed Hepatitis B when vaccinated with the HBV vaccine, either alone or in combination with Hepatitis B Immunoglobulin (HBIG). This finding demonstrates the efficacy of vaccination in preventing MTCT under optimal conditions. In contrast, Yonghao et al. (2022) documented a transmission rate of 1.9% among infants born to HBV-positive mothers who received vaccination, suggesting that maternal HBV status and viral load play a critical role in determining transmission outcomes. Meanwhile, Yao et al. (2022) highlighted the transformative impact of introducing the HBV vaccine, showing a dramatic reduction in MTCT incidence from 82.9% to 15.9%. These studies collectively underscore the potential of the HBV vaccine to significantly reduce MTCT but also highlight the challenges posed by variations in maternal factors and healthcare systems.

A similar pattern of variability is observed in sub-Saharan Africa, where healthcare resources are often limited, and access to supplementary preventive measures like HBIG is inconsistent. For example, a study conducted in Ghana reported an MTCT rate of 5.9% following the introduction of the HBV vaccine (Hambridge et al., 2019). This

rate is higher than the 4.26% MTCT rate documented in Abyei, South Sudan. These differences can be attributed to several factors, including disparities in healthcare delivery, adherence to vaccination schedules, and the availability of essential resources. In regions where healthcare infrastructure is robust, vaccination programs tend to be more successful. However, in resource-limited settings, logistical challenges, such as inadequate cold chain facilities, shortages of trained healthcare workers, and delays in vaccination initiation, can undermine the effectiveness of these programs.

The findings from Abyei underscore the importance of addressing these disparities through targeted interventions designed to enhance the accessibility and affordability of comprehensive vaccination programs. Vaccination alone, while a critical component of MTCT prevention, is insufficient in settings where systemic barriers impede the timely and consistent delivery of healthcare services. Integrating supplementary measures, such as HBIG administration and maternal antiviral therapy, into routine healthcare protocols can significantly improve outcomes. This approach is particularly important in high-burden areas like Abyei, where maternal viral loads are often not monitored, and opportunities for early intervention may be missed.

One of the key factors influencing the effectiveness of the HBV vaccine in preventing MTCT is the maternal viral load. Research consistently identifies high maternal viral loads as a significant risk factor for MTCT, even when the HBV vaccine and HBIG are administered to the infant. High levels of circulating virus in the mother increase the likelihood of transmission during childbirth, necessitating additional preventive strategies. The World Health Organization (WHO) recommends antiviral therapy during pregnancy for women with high viral loads to further reduce the risk of transmission. This recommendation underscores the importance of integrating maternal care into broader HBV prevention efforts.

Studies from high-income countries demonstrate the feasibility and effectiveness of combining maternal antiviral therapy with infant vaccination and HBIG administration. For example, research conducted in the United States and Europe has shown that such integrated approaches can reduce MTCT rates to less than 1%, even among mothers with high viral loads. These successes are attributed to well-established healthcare infrastructure, consistent access to antiviral medications, and rigorous adherence to vaccination protocols. These integrated models serve as benchmarks for implementation in resource-limited settings, offering a roadmap for reducing MTCT where healthcare systems are less developed.

In resource-limited settings like Abyei, however, implementing such integrated approaches poses significant challenges. Maternal antiviral therapy is often unavailable due to high costs, limited healthcare infrastructure, and a lack of trained personnel to monitor viral loads and administer treatment. Addressing these barriers requires substantial investments in healthcare systems to improve access to diagnostics, medications, and skilled healthcare providers. Establishing reliable supply chains for antiviral drugs and HBIG is also critical to ensuring that these resources are available when needed.

Another critical factor influencing MTCT prevention is adherence to vaccination schedules. The HBV birth dose vaccine is most effective when administered within 24 hours of delivery, as it prevents the virus from establishing an infection in the newborn. However, delays in vaccination initiation are common in resource-limited settings due to logistical challenges, such as the unavailability of vaccines or healthcare workers at the time of delivery. Incomplete vaccination schedules further exacerbate the risk of MTCT, as infants who do not receive the full series of vaccine doses are left vulnerable

to infection. Ensuring timely and complete vaccination requires strengthening healthcare systems to address logistical and operational challenges.

Public health education also plays a crucial role in improving adherence to vaccination schedules. Many mothers in high-burden regions like Abyei are unaware of the importance of the birth dose vaccine and the need to complete the full vaccination series. Community-based education campaigns can help raise awareness about HBV prevention and encourage mothers to prioritize timely vaccination for their infants. Engaging community leaders, religious figures, and traditional healers in these efforts can enhance their reach and impact, promoting behavior change and increasing vaccine uptake.

Financial barriers further hinder access to comprehensive MTCT prevention services. In low-income regions, many families cannot afford the costs associated with maternal antiviral therapy, HBIG, or even the HBV vaccine. Subsidizing these services or offering them free of charge can significantly increase access and improve outcomes. Governments and international organizations must prioritize funding for HBV prevention programs to ensure their sustainability and effectiveness. Providing financial support for high-burden regions like Abyei can help bridge the gap in healthcare equity and ensure that all families have access to life-saving interventions.

Collaboration between governments, non-governmental organizations, and international agencies is essential for addressing the systemic barriers to MTCT prevention. These partnerships can provide the financial, technical, and logistical support needed to strengthen healthcare systems and ensure the consistent delivery of HBV prevention services. Donor funding can help establish cold chain infrastructure, train healthcare workers, and procure essential resources like HBIG and antiviral medications.

Technical assistance can support the development of protocols for integrating maternal care into routine healthcare services, ensuring that HBV prevention is prioritized at every level of the healthcare system.

Monitoring and evaluation are critical for measuring the impact of HBV prevention programs and identifying areas for improvement. Regular data collection on MTCT rates, vaccination coverage, and maternal viral load monitoring can provide valuable insights into program effectiveness and guide future interventions. Investing in research to better understand the local epidemiology of HBV, including risk factors for transmission and barriers to care, can inform targeted strategies for improving outcomes in high-burden regions.

The effectiveness of the HBV vaccine in preventing MTCT varies widely across different settings, influenced by factors such as maternal viral load, adherence to vaccination protocols, and healthcare infrastructure. While studies in China and other high-income countries demonstrate the potential for near-elimination of MTCT through integrated approaches, resource-limited settings like Abyei face significant challenges in implementing these strategies. Addressing systemic barriers, such as limited access to antiviral therapy, HBIG, and timely vaccination, is essential for improving outcomes in these regions. By investing in healthcare infrastructure, enhancing community awareness, and fostering collaboration among stakeholders, it is possible to reduce MTCT rates and protect future generations from the burden of HBV.

The barriers to effective MTCT prevention in sub-Saharan Africa extend beyond healthcare infrastructure and access. Socio-economic factors, cultural beliefs, and systemic inequities also play critical roles in shaping outcomes. For instance, financial constraints often limit access to vaccination and healthcare services, particularly in low-

income communities. Out-of-pocket expenses for HBIG and the HBV vaccine can deter families from seeking preventive care. Additionally, cultural misconceptions about Hepatitis B, its transmission, and the importance of vaccination may contribute to low uptake of available services. Addressing these barriers requires not only the expansion of healthcare services but also community engagement and education to raise awareness about the importance of MTCT prevention.

Efforts to improve MTCT prevention in regions like Abyei must focus on integrated approaches that combine vaccination with other preventive measures. Ensuring timely administration of the HBV vaccine, HBIG, and the zero-dose vaccine is critical. Strengthening healthcare systems to provide comprehensive maternal and child health services, including routine screening for HBV and access to antiviral therapy, is equally important. Moreover, community-based interventions aimed at increasing awareness and reducing stigma associated with Hepatitis B are essential for improving healthcare-seeking behavior and vaccination coverage.

The findings of this study highlight the urgent need for targeted interventions to reduce the burden of MTCT in Abyei and similar settings. While the HBV vaccine remains a cornerstone of prevention efforts, its effectiveness can be significantly enhanced through the integration of supplementary measures and the removal of barriers to access. Addressing these challenges will require a concerted effort from governments, healthcare providers, and international organizations to ensure that every child born to an HBV-positive mother has the best possible chance of being protected from infection. By adopting comprehensive and context-specific strategies, it is possible to reduce the burden of MTCT and safeguard the health of mothers and infants worldwide..

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary of findings, conclusions, and recommendations derived from the study. The recommendations are organized as per the objectives of the study.

5.1 Summary of Findings

The research conducted an in-depth exploration of the seroprevalence of Hepatitis B virus (HBV) and the effectiveness of vaccination programs in mitigating vertical transmission among pregnant women who attended antenatal clinics in Abyei, South Sudan. The study employed a robust mixed-methods approach, incorporating both quantitative and qualitative research methodologies. Data collection was meticulously carried out through the administration of structured questionnaires to the participants, complemented by interviews with key informants who provided expert insights. Additionally, focus group discussions were utilized to gain a deeper understanding of the social and cultural factors influencing vaccination uptake and the overall management of Hepatitis B in the study population.

The findings of the study highlighted a significant prevalence of Hepatitis B among pregnant women, with a rate reaching 19%, which categorizes the study area as a high-endemic region for Hepatitis B. This notable prevalence underscores the pressing public health challenge posed by the virus in the region. Alarmingly, the study revealed that none of the women included were aware of the presence of Hepatitis B within the community or its associated health risks. This finding points to a profound gap in knowledge and awareness regarding Hepatitis B among the population, emphasizing

the critical need for targeted educational and public health interventions to address this lack of understanding and improve community health outcomes.

The study identified several risk factors associated with Hepatitis B infection among pregnant women, painting a comprehensive picture of the contributors to the virus's prevalence. Key risk factors included the early onset of sexual activity, which increases the likelihood of exposure to sexually transmitted infections (STIs), and a history of STIs, which is closely linked to higher susceptibility to Hepatitis B. Intravenous drug use was also flagged as a significant risk factor, reflecting the role of unsafe injection practices in transmitting the virus. Additionally, cohabitation with individuals already diagnosed with Hepatitis B emerged as a critical risk factor, pointing to the potential for household transmission. Interestingly, seemingly innocuous cultural or cosmetic practices, such as ear piercing, were also highlighted as potential contributors, emphasizing the multifaceted and interconnected nature of the risk factors that facilitate the spread of Hepatitis B within the community. These findings underscore the importance of adopting a holistic approach to prevention and education strategies to mitigate these diverse risk factors effectively.

The study revealed a wide range of challenges and barriers that hinder the effectiveness of Hepatitis B prevention efforts in the region, highlighting systemic and community-level obstacles. Among the key challenges identified was the absence of routine screening services, which limits early detection and management of the virus, as well as a lack of prophylactic interventions, such as timely administration of vaccines and immunoglobulin to prevent vertical transmission. The region's limited healthcare infrastructure further exacerbates the problem, with inadequate facilities and resources impeding the delivery of comprehensive care.

Insufficient awareness-raising initiatives emerged as a significant gap, leaving communities ill-informed about the risks, transmission, and prevention of Hepatitis B. Compounding this were deficiencies in the healthcare workforce, including a lack of training and expertise to handle Hepatitis B cases effectively. The study also highlighted the failure to establish strong linkages between diagnosed individuals and treatment services, leaving many without access to necessary care.

Cultural beliefs and taboos surrounding Hepatitis B were found to play a significant role in perpetuating stigma and preventing open discussion or timely intervention. Systemic weaknesses within the healthcare system, such as poor coordination and resource allocation, further hindered prevention efforts. Finally, financial barriers to accessing healthcare services were identified as a critical impediment, limiting the ability of many individuals to seek or afford the care they need. These findings underscore the urgent need for a multi-pronged approach to address these barriers and strengthen Hepatitis B prevention and management strategies in the region.

The study further revealed that the administration of the Hepatitis B vaccine alone was inadequate in fully preventing mother-to-child transmission of the virus. This critical finding highlights the limitations of relying solely on vaccination as a prevention strategy, emphasizing the necessity for a more comprehensive approach. Such strategies should integrate vaccination with targeted interventions addressing the underlying risk factors and structural barriers that perpetuate Hepatitis B transmission. These barriers include gaps in maternal screening programs, lack of access to timely prophylactic measures, and broader systemic challenges within healthcare delivery.

The study also underscores the importance of strengthening healthcare infrastructure, enhancing community awareness, and fostering behavioral change to tackle the

multifaceted drivers of transmission. Addressing these issues holistically will ensure more effective and sustainable prevention of Hepatitis B transmission, particularly from mothers to their children, and ultimately improve community health outcomes.

5.2 Conclusion

The findings of this study highlight the substantial public health challenges posed by Hepatitis B among pregnant women in Abyei, South Sudan. The prevalence rate of 19% among expectant mothers attending antenatal care services is alarmingly high, categorizing the area as a high-endemic region. This prevalence not only exceeds global and regional averages but also signals an urgent public health crisis requiring immediate and targeted interventions to prevent mother-to-child transmission and mitigate associated health risks.

Compounding the issue is the pervasive lack of awareness regarding Hepatitis B among pregnant women in Abyei, as evidenced by a 100% unawareness rate identified in the study. This profound knowledge gap represents a critical barrier to effective prevention efforts, limiting the community's ability to recognize risks, seek timely interventions, and adopt protective behaviors.

These findings underscore the pressing need for tailored awareness campaigns designed to address the unique sociocultural and structural challenges of Abyei. Such initiatives should focus on empowering women with knowledge about Hepatitis B, its transmission, and prevention methods while integrating community engagement to foster acceptance and participation in prevention programs. This multifaceted approach is essential for effectively combating the high prevalence of Hepatitis B and improving maternal and neonatal health outcomes in the region.

The study identifies a range of risk factors contributing to the seroprevalence of Hepatitis B among pregnant women, offering critical insights into the complexity of the virus's transmission in the region. Key risk factors include an early age of first sexual encounter, a history of sexually transmitted infections (STIs), drug use, cohabitation with a husband infected with HBV, and cultural practices such as nose piercing. These findings underscore the multifaceted and interlinked nature of Hepatitis B transmission, highlighting the need for targeted and culturally sensitive interventions to mitigate these risks effectively.

A concerning revelation from the study pertains to the effectiveness of the Hepatitis B vaccine in preventing mother-to-child transmission. Despite vaccination efforts, 4.26% of vaccinated children tested positive for HBV, a rate significantly higher than those reported in some international studies. This raises critical questions regarding the vaccine's efficacy in the local context, potentially stemming from factors such as improper vaccine storage, delayed administration, or gaps in healthcare delivery systems.

These findings call for urgent action to enhance the effectiveness of vaccination programs, including improving healthcare infrastructure, ensuring adherence to vaccination protocols, and conducting further research to identify and address local challenges. Additionally, continuous monitoring and evaluation of vaccination outcomes are imperative to optimize prevention strategies and achieve better health outcomes in the community.

The qualitative analysis provided a nuanced understanding of the complex dynamics surrounding Hepatitis B in Abyei, offering rich insights into the lived experiences and perspectives of the participants. This aspect of the study uncovered a spectrum of

contributing factors and challenges that extend beyond clinical considerations, highlighting the social, cultural, and systemic barriers that exacerbate the burden of Hepatitis B.

Participants identified unskilled delivery practices and low attendance at antenatal care as significant contributors to the spread of Hepatitis B, underscoring gaps in maternal health services. Risk behaviors such as having multiple sexual partners, the practice of wife inheritance, and non-hygienic cultural practices were also highlighted as key drivers of transmission. Additionally, the impact of gender-based violence was noted, with its implications for women's vulnerability to infection further emphasizing the intersectionality of health and social inequities.

The analysis further revealed systemic and structural barriers, including the collapse of the health system, which has led to inadequate healthcare delivery and a disrupted supply chain for essential medical supplies, such as vaccines and screening tools. Cultural beliefs and taboos surrounding Hepatitis B emerged as critical barriers, perpetuating stigma and preventing open discussion and early intervention. These findings underscore the need for a multi-layered response, combining health system strengthening, community education, and culturally sensitive interventions to address the deep-rooted factors contributing to Hepatitis B transmission in the region.

5.3 Recommendations

5.3.1 Recommendations for Practice

The South Sudanese Government should implement practices that promote early and regular attendance at antenatal care. This can include community-based initiatives, improved healthcare accessibility, and culturally sensitive approaches to encourage pregnant women to seek care. Integrate hepatitis B preventive services into routine

antenatal care, including screening, vaccination, and awareness programs. This can be achieved by training healthcare professionals, providing necessary resources, and ensuring the availability of prophylactic services for infants. Provide antiviral treatment for pregnant women with high viral loads to reduce the risk of mother-to-child transmission (MTCT). Additionally, ensure access to hepatitis B vaccination for infants born to HBV-positive mothers as part of a comprehensive prevention strategy. The Government should also establish community engagement programs to address cultural beliefs and practices that contribute to the spread of hepatitis B infection. Involve local leaders, community health workers, and influencers to effectively communicate the importance of preventive measures. The government should also develop targeted interventions for high-risk groups identified in the study, such as individuals with a history of STIs, intravenous drug use, or living with partners infected with HBV. These interventions should include education, counseling, and support services. Integrate hepatitis B screening, prevention, and treatment services into comprehensive sexual and reproductive health services to address both sexually transmitted infections (STIs) and hepatitis B among pregnant women. This approach can improve maternal and child health outcomes.

5.3.2 Recommendations for Policy

Given the concerns raised about the lack of testing facilities and uncertainties regarding the actual burden of hepatitis B, policy efforts should focus on improving testing infrastructure in Abyei aend South Sudan. This involves investing in diagnostic equipment, training healthcare professionals, and ensuring accessibility to testing facilities for pregnant women. Public health awareness campaigns should be developed and implemented to increase knowledge about hepatitis B among pregnant women and the general population in Abyei. These campaigns should utilize various

communication channels, including community engagement, to address the observed low awareness levels. Integrate specific policies and interventions aimed at preventing mother-to-child transmission of hepatitis B into existing maternal and child health programs. This includes ensuring access to timely and effective vaccination strategies for pregnant women and infants. Health policies should be designed to address the unique risk factors identified in the study, such as unskilled delivery practices, low attendance at antenatal care, and multiple sexual partners. These policies should be culturally sensitive and tailored to the local context. Develop and implement health education campaigns to increase awareness about hepatitis B among pregnant women and the wider community. These campaigns should address misconceptions, cultural beliefs, and stigma associated with hepatitis B to promote prevention and early detection. Establish subsidized or free vaccination programs to improve access to hepatitis B vaccination for pregnant women and infants. This can help overcome financial barriers and ensure high vaccination coverage rates. Integrate hepatitis B screening, vaccination, and treatment services into existing maternal and child health programs to ensure comprehensive care for pregnant women and infants at risk of hepatitis B infection. Strengthen the healthcare system by investing in infrastructure, human resources, and supply chains to support the delivery of hepatitis B prevention and treatment services. This includes training healthcare workers and improving access to essential medicines and diagnostic tools.

5.3.3 Recommendations for Further Studies

Further studies should be conducted to investigate the factors contributing to the relatively higher number of vaccinated children testing positive for HBV. This includes assessing the effectiveness of the hepatitis B vaccine in the local context, potential challenges in vaccine administration, and reasons behind vaccine failure. Longitudinal

studies should also be undertaken to assess the long-term impact of maternal hepatitis B infection on adverse pregnancy outcomes and the development of chronic infections in infants. This can provide insights into the persistence of risks beyond the early years of life. In-depth studies should be conducted on cultural and behavioral factors influencing the spread of hepatitis B, with a focus on gender-based violence, wife inheritance, and other practices identified as potential contributors. This knowledge can inform the design of culturally sensitive interventions. Investigate and address the challenges within the health system, including the collapsed health system and inadequate supply chain.

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APPENDICES

Appendix I: Consent Form

Study Title: **Seroprevalence of Hepatitis B and Vaccine Effectiveness in Vertical Transmission Prevention among Pregnant Mothers in Abyei, South Sudan**

Principal Investigator: **Ramzy Muorwel Matueny**
Institution: **Mount Kenya University**

Dear Participant,
You are being invited to participate in a research study titled "Seroprevalence of Hepatitis B and Vaccine Effectiveness in Vertical Transmission Prevention among Pregnant Mothers in Abyei, South Sudan." Before deciding, it is essential that you read and understand the information provided in this consent form or you listen carefully as we explain the content. This form will outline the purpose, procedures, potential risks, benefits, and confidentiality measures related to the study. If you agree to participate, you will be asked to provide your informed consent by signing this document.

Purpose of the Study:
The purpose of this study is twofold: (1) to ascertain the rate of vertical transmission of Hepatitis B virus among pregnant women in Abyei, South Sudan; and (2) to assess the effectiveness of the Hepatitis B vaccine in this regard. The primary purpose of the research is to increase our knowledge of the frequency of Hepatitis B and the efficacy of vaccination efforts in preventing the spread of the virus.

Procedures:
If you agree to participate, the following procedures will be conducted:
Informed consent: You will be required to sign this consent form, indicating your voluntary participation in the study.
Questionnaire: You will be asked to complete a questionnaire that collects information about your demographic details and potential risk factors associated with Hepatitis B transmission.
Blood Sample Collection: A trained healthcare professional will collect a small blood sample (approximately 5 ml) from your arm for serological testing. The blood sample will be used to determine your Hepatitis B status only.

Potential Risks:
The risks associated with participating in this study are minimal. The blood sample collection may cause temporary discomfort, such as mild pain, bruising, or infection at the site of the needle prick. However, all necessary precautions will be taken to minimize these risks, and the blood collection will be performed by trained professionals following standard procedures.

Benefits:
As a participant in this study, you will contribute to the understanding of Hepatitis B seroprevalence and vaccine effectiveness, which may ultimately help in improving preventive strategies and healthcare interventions for pregnant mothers and their infants in Abyei, South Sudan. Additionally, you will receive the results of your blood test,

including your Hepatitis B status, free of charge. If the results indicate a Hepatitis B infection, appropriate medical referral and counseling will be provided.

Confidentiality:
Your participation in the research will be kept completely secret. The information we gather will be stored safely and in complete confidence. Your data will be encrypted and rendered anonymous to protect your privacy. Data will be accessible only to authorized research staff, and results will be provided in aggregate form to protect the privacy of study participants.

Voluntary Participation and Right to Withdraw:
Everyone involved in this research is doing it of their own free will. You are under no obligation to continue with the research and may discontinue participation at any time without penalty. Your current and future medical treatment will not be affected by your choice to participate or withdraw.

Contact Information:
If you have any questions or concerns about the study, you can contact the Principal Investigator, Dr. Ramzy Muorwel on 0925004343/0912520024 or email at ramzymuorwel@gmail.com
Date of interview: ……
Village: ……
Boma: ……
Payam: ……
County: ……
Facility: ……

Respondent signature/thumb print:……..

Appendix II: Structured Questionnaires

A. Awareness of HBV among ANC mothers

1. Is hepatitis B a virus?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

2. Does hepatitis B affect the liver?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

3. Can hepatitis B be transmitted through unsterilized needles, blades and other sharp material?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

4. Can hepatitis B be transmitted by contaminated blood and blood products?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

5. Is hepatitis B transmitted through unsafe sex?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

6. Can hepatitis B be transmitted through kissing?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

7. Can an infected person remain without symptoms?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

8. Can hepatitis B affect any person?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

9. Will an infected person remain infected for life?

   Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

10. Is a specific diet required for all infected persons?

    Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

11. Can hepatitis B infection cause liver cancer?

    Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

12. Can hepatitis B be prevented by vaccination?

    Yes = 1 ☐ No = 2 ☐ Not know = 3 ☐

B. Risk of HBV among ANC mothers

13. At what age did you start sexual life?

    13-15 years = 1 ☐ 16 years and above = 2 ☐

14. How many partners do have relationship with?

    1 = 1 ☐ >1 = 2 ☐

15. Have you ever had surgical operations?

Yes = 1 ☐ No = 2 ☐

16. If yes in 15 above, were transfused with the blood?

Yes = 1 ☐ No = 2 ☐

17. Are you suffering from any STI?

Yes = 1 ☐ No = 2 ☐

18. Have you been using intravenous drugs/ medications?

Yes = 1 ☐ No = 2 ☐

19. Is your husband or anyone living with you have HBV?

Yes = 1 ☐ No = 2 ☐

20. Are you on medications that suppress immunity?

Yes = 1 ☐ No = 2 ☐

21. Are your ears or nose pierced?

Yes = 1 ☐ No = 2 ☐

22. How old are you?

15-25 years = 1 ☐ 26-30 = 2 ☐ >30 = 3 ☐

23. What is your educational level?

Not been to school = 1 ☐ primary = 2 ☐ secondary = ☐ 3

24. Are you employed?

Employed = 1 ☐ unemployed = 2 ☐ student = 3 ☐

25. If employed, what is your income?

10,000-20,000 SSP = 1 ☐ >20,000 SSP = 2 ☐

26. What is your marital status?

unmarried = 1 ☐ monogamy = 2 ☐ polygamy = 3 ☐

27. At what gestational age are you in?

first trimester = 1 ☐ second trimester = 2 ☐ third trimester = 3 ☐

28. What is your parity?

Primipara 1 child = 1 ☐

Multipara 2-4 children = 2 ☐

Granmultipara >4 children = 3 ☐

29. Is your husband working?

Yes = 1 ☐ No = 2 ☐

30. If yes above, does he sleep away on job?

Yes = 1 ☐ No = 2 ☐

31. Where was your previous of delivery?

Home = 1 ☐ facility = 2 ☐

32. Are there HBV screening test available that you know?

Yes = 1 ☐ No = 2 ☐

33. If yes above, what is the cost of screening?

Free = 1☐ affordable = 2☐ costly =3☐

34. Is your husband alive?

Yes = 1 ☐ No = 2 ☐

35. If no above, who is cohabiting with you?

Brother in-law=1 ☐ non relative = 2 ☐

36. Are there specific traditional marks/scars on your body?

Yes = 1 ☐ No = 2 ☐

D. Seroprevalence of Hepatitis B among the ANC mothers

37. Test result positive for HBsAg

Yes = 1 ☐ No = 2 ☐

E. Effectiveness of vaccine assessment

38. Was the child given birth dose hepatitis B vaccine within 12 hours?

Yes = 1 ☐ No = 2 ☐

39. Did the child receive HBIG with 12 hours of birth?

Yes = 1 ☐ No = 2 ☐

40. Did the child finish three doses of HBV vaccines in penta1 penta 2 penta 3?

Yes fully received=1 ☐ partially received = 2 ☐

41. Is the child positive for HBsAg?

Yes = 1 ☐ No = 2 ☐

Appendix III: Key Informants Interview Objectives

Objective 1: Sero-prevalence of Hepatitis B virus among pregnant mothers seeking antenatal care in Abyei, South Sudan

Objective 2: Awareness of HBV among ANC mothers:

Objective 3: Risk of HBV among ANC mothers: Multi-sexual partners, Previous history of surgeries and blood transfusion, History of STIs, Use of illicit intravenous drugs, Sexual partner or living with someone positive with HBV, Use of immune- suppressive drugs and Ear piercing

Objective 4: Barriers and challenges to hepatitis B prevention

Objective 5: Effectiveness of HBV vaccine in preventing vertical transmission, Offering of vaccine for HBsAg positive mothers during Pregnancy, Vaccination of infants with birth dose, Infants testing HBsAg positive after vaccination completion

Appendix IV: Guide to the KII

Date of interview: ……. Village……. ….

Boma…….....

Payam…… County……. Facility……

1. How big do you think the burden of hepatitis B is among the pregnant women?
2. What level of awareness do you think the pregnant mothers are about the hepatitis B?
3. What do you think are the risks of hepatitis B infection among pregnant women?
4. What are barriers and challenges to prevention of hepatitis B among pregnant mothers?

Appendix V: Qualitative data

Focus Group Discussion (FGDs) and Key informants Interview data

How big do you think the burden of hepatitis B is among the pregnant women?

- The burden of hepatitis B is high among the expectant mothers
- It can range from medium to high
- Hepatitis is very high among the pregnant mothers
- The burden is not known because of lack of testing facilities
- Hepatitis burden could be low among the pregnant mothers

What level of awareness do you think the pregnant mothers are about the hepatitis B?

- Pregnant mothers are unaware of Hepatitis B virus
- The level of awareness is low
- It is not known because no study was ever conducted about it in this area
- There are no awareness activities around and is expected to be very low

What do you think are the risks of hepatitis B infection among pregnant women?

- Unskilled delivery is common among women in this area and poses a risk of hepatitis B to both mother and her child
- Pregnant mothers don't turn up for antenatal care and this carries risk of undiagnosed hepatitis B from mother to child
- Having multiple sexual partners is being practiced by some people
- There is wife inheritance in community where men inherit wives of late relatives who died of hepatitis B
- Ear and nose piercing using non-disposable instruments is practiced among women and this is a risk of infection
- Lack of knowledge and awareness of hepatitis B and its transmission route
- Weak health system and low quality of care in the clinics that may lead to poor infection control
- Gender based violence including rape are coming up nowadays due to insecurity and victims are at risk of STIs including Hepatitis B

What are barriers and challenges to prevention of hepatitis B among pregnant mothers?

- Lack of screening services in Abyei for pregnant women
- Lack of prophylactic hepatitis B services for infants whose mothers are positive
- Lack of awareness raising activities
- Low socio-economic status of the population
- Absence of linkages to treatment services make women reluctant to take test they perceive hepatitis B as infection of no medical solution
- Limited access to antenatal services poses missed opportunities for pregnant women to access screening facilities
- Low skills and lack of training among health care workforce
- Cultural beliefs and taboos
- Lack of vaccine and if available its affordability by the pregnant mothers is a challenge
- Collapsed health system leading to inadequate supply chain.

Appendix VI: Authorization Letter (MoH Sudan)

REPUBLIC OF SOUTH SUDAN
ABYEI SPECIAL ADMINISTRATIVE AREA
STATE MINISTRY OF HEALTH

Date: 16/11/2023

TO WHOM IT MAY CONCERN

RE: RAMZY MUORWEL MATUENY – REG. NO. PHDPH/2022/33710

1) The above **PhD Student from Mount Kenya University** presented his research proposal titled "**Seroprevalence of Hepatitis B and Vaccine Effectiveness in Vertical Transmission Prevention Among Pregnant Mothers Attending Antenatal Clinics in Abyei, South Sudan**"

2) The Ministry of Health reviewed the document and found no issues of concern to the participants.

3) ***The Ministry therefore granted clearance for the researcher and his team to conduct data collection as outlined in the protocol.***
4) All concern bodies and individuals are requested to render possible assistance to the team to conduct this study

Kind regards;

Deng Chol Bang
Director General
State Ministry of Health
Abyei Special Administrative Area – Abyei

SPECIAL ADMINISTRATIVE AREA
DIRECTOR GENERAL
MINISTRY OF HEALTH

Appendix VI: Ethical Clearance

Mount Kenya University

REF: **MKU/ISERC/3333**
TO: **RAMZY MUORWEL MATUENY**

Date: 15 November 2023

REG: **PhDPH/2022/33710**

Dear Sir/Madam,

RE: SEROPREVALENCE OF HEPATITIS B AND VACCINE EFFECTIVENESS IN VERTICAL TRANSMISSION PREVENTION AMONG PREGNANT MOTHERS ATTENDING ANTENATAL CLINICS IN ABYEI, SOUTH SUDAN

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2377.** The approval period is **15/11/2023 - 14/11/2024.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

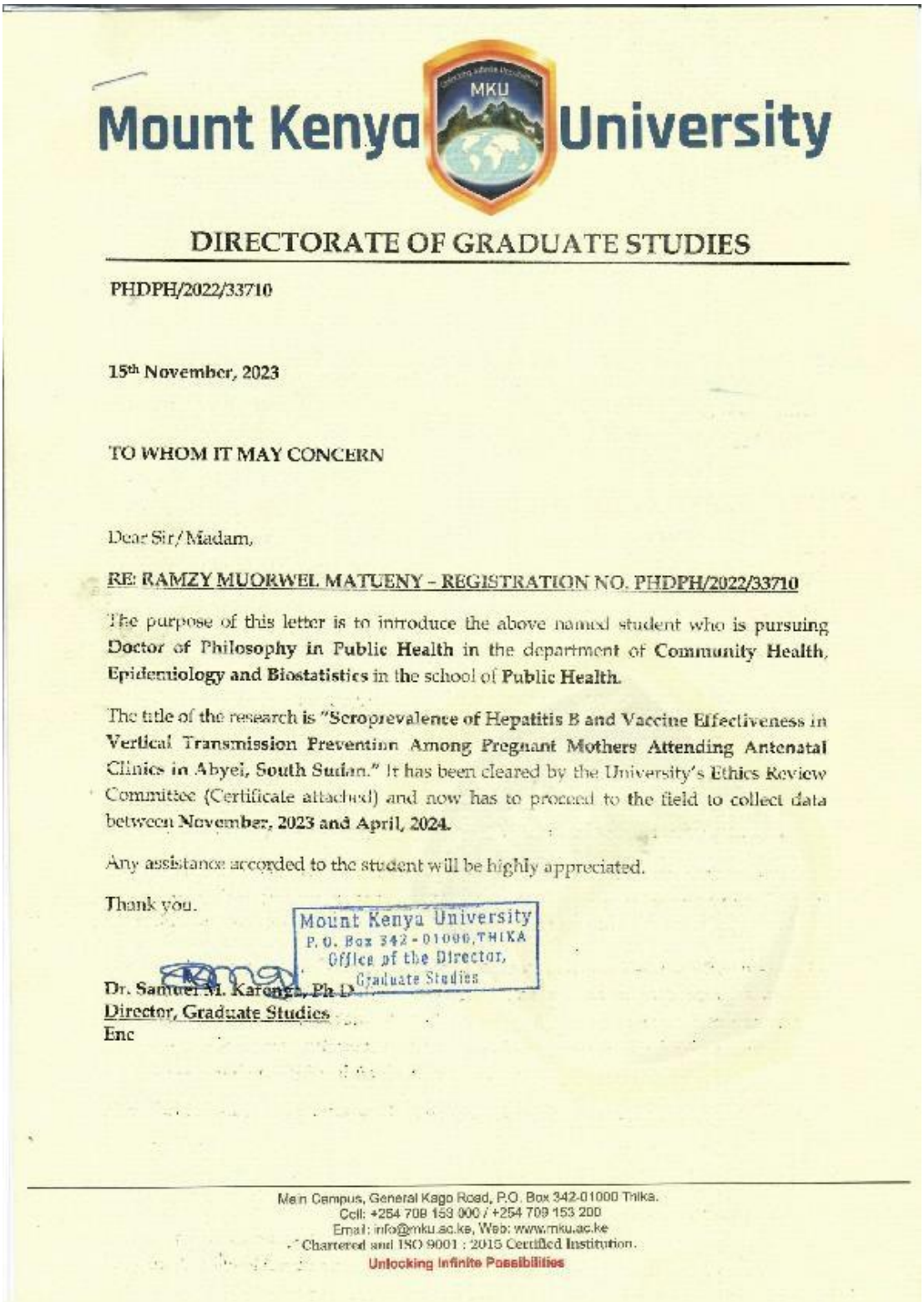
Prior to commencing your study, you will be expected to comply with any additional requirements from the relevant authorities in the country where this study will be conducted

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P.O. Box 342-01000, Thika

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Appendix: VII: Introduction Letter



Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

PHDPH/2022/33710

15th November, 2023

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: RAMZY MUORWEL MATUENY – REGISTRATION NO. PHDPH/2022/33710

The purpose of this letter is to introduce the above named student who is pursuing **Doctor of Philosophy in Public Health** in the department of **Community Health, Epidemiology and Biostatistics** in the school of **Public Health.**

The title of the research is **"Seroprevalence of Hepatitis B and Vaccine Effectiveness in Vertical Transmission Prevention Among Pregnant Mothers Attending Antenatal Clinics in Abyei, South Sudan."** It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **November, 2023 and April, 2024.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Karonga, Ph D
Director, Graduate Studies
Enc

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
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Appendix VIII: Originality Report

Seroprevalence Of Hepatitis B And Vaccine Effectiveness In Vertical Transmission Prevention Among Pregnant Wom...

by Turnitin LLC

Submission date: 08-Jan-2025 01:18AM (UTC-0800)
Submission ID: 2561028597
File name: Ramzy_Muorwel_Matueny_Thesis_-_Post_defence_corrections_.docx (1.53M)
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Character count: 301644

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