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of Science Education



Faculty of Commerce

***The Impact of Total Health Expenditure on Maternal Mortality (1990-
2023)***

by

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The Dissertation is submitted in Partial Fulfillment of the requirements for Master of Science
Degree in Health Economics

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RELEASE FORM

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DECLARATION

I, Tawanda Chitambara, declare that this research project is my own work and has not been copied from any source without proper acknowledgment.

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DEDICATIONS

I dedicate this dissertation with deep gratitude, honor, and pleasure to my mother and my family for their encouragement during my studies.

ABSTRACT

The main goal of this study is to analyze the effect of total health expenditure on maternal mortality in Zimbabwe from 1990 to 2023. The research was carried out due to the observed increase in funding and allocation for health programs, along with fluctuations in maternal mortality rates. To explore the relationship between total health expenditure and maternal mortality, an ordinary least squares method was used, including control variables such as education, health workforce density, and access to health services. Time series data obtained from the World Bank and analyzed with statistical software showed that total health expenditure has a significantly positive relationship with maternal mortality. Additionally, the study found that access to health services is positively related to maternal mortality, while health workforce density and education are negatively related. Based on these findings, the researcher suggests potential solutions to lower maternal mortality, such as improving access to health services and increasing efficiency in health spending to improve health outcomes.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1. INTRODUCTION

The study explores the impact of total health expenditure on maternal mortality in Zimbabwe. Understanding how health spending affects maternal mortality is important for several reasons. First, maternal mortality ratio is a key measure of a country's health system performance, and lowering it is vital for reaching Sustainable Development Goal number three, which aims to reduce the global maternal mortality ratio to 70 per 100,000 live births (United Nations, 2015). Second, Zimbabwe's donor funding is decreasing because of the United States of America's executive orders, and knowing how to optimize health spending can help policymakers make better decisions about resource allocation. The study will use secondary data from various sources, such as the Zimbabwe National Health Accounts, ZIMSTAT, the Ministry of Finance, Economic Development and Investment Promotion, the Ministry of Health and Child Care, the World Health Organization (WHO), and the World Bank.

1.2. BACKGROUND OF THE STUDY

The World Health Organization (WHO) emphasizes maternal health as a key indicator of the overall effectiveness of health systems. WHO highlights that most maternal deaths are preventable, including excessive blood loss, infections, high blood pressure, unsafe abortions, and obstructed labor, along with indirect causes such as anemia, malaria, and heart disease (World Health Organization, 2022). Maternal mortality remains a major public health challenge worldwide, with low- and middle-income countries bearing a disproportionate burden.

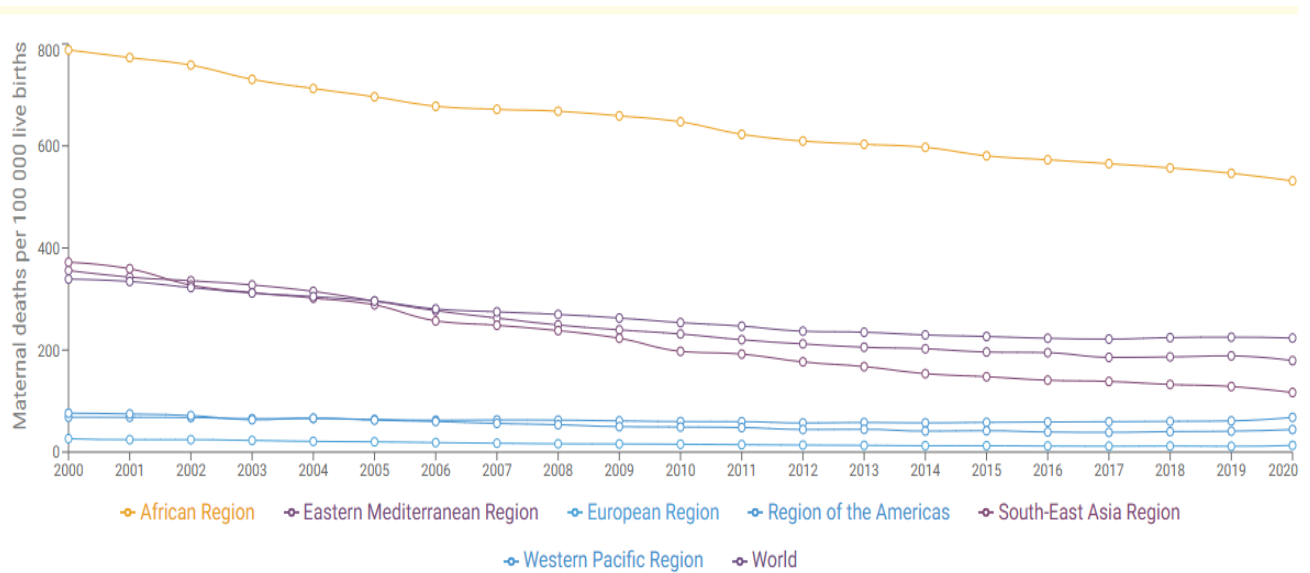


Figure 1: Continental trends in maternal mortality rates (source: World Health Organization, 2025)

The diagram above shows that maternal deaths have declined over the past two decades. The African Region remains the region with the highest maternal mortality ratio (MMR), and the rate of decline has been nearly stagnant. The South-East Asia Region experienced the most decline, decreasing MMR from 372 deaths per 100,000 live births in 2000 to 117 deaths per 100,000 live births in 2020. In the European Region, MMR was at 100 in 2000 and began to increase to around 120-140 between 2016 and 2020. The African region’s MMR dropped from 800 to 520 in 2020, indicating significant progress in reducing MMR. However, at 520, it shows that more women are dying, signaling that additional efforts are needed to meet the 2030 target of 70 per 100,000 live births (Sustainable Development Goals 2015).

Maternal Mortality Ratio in SADC

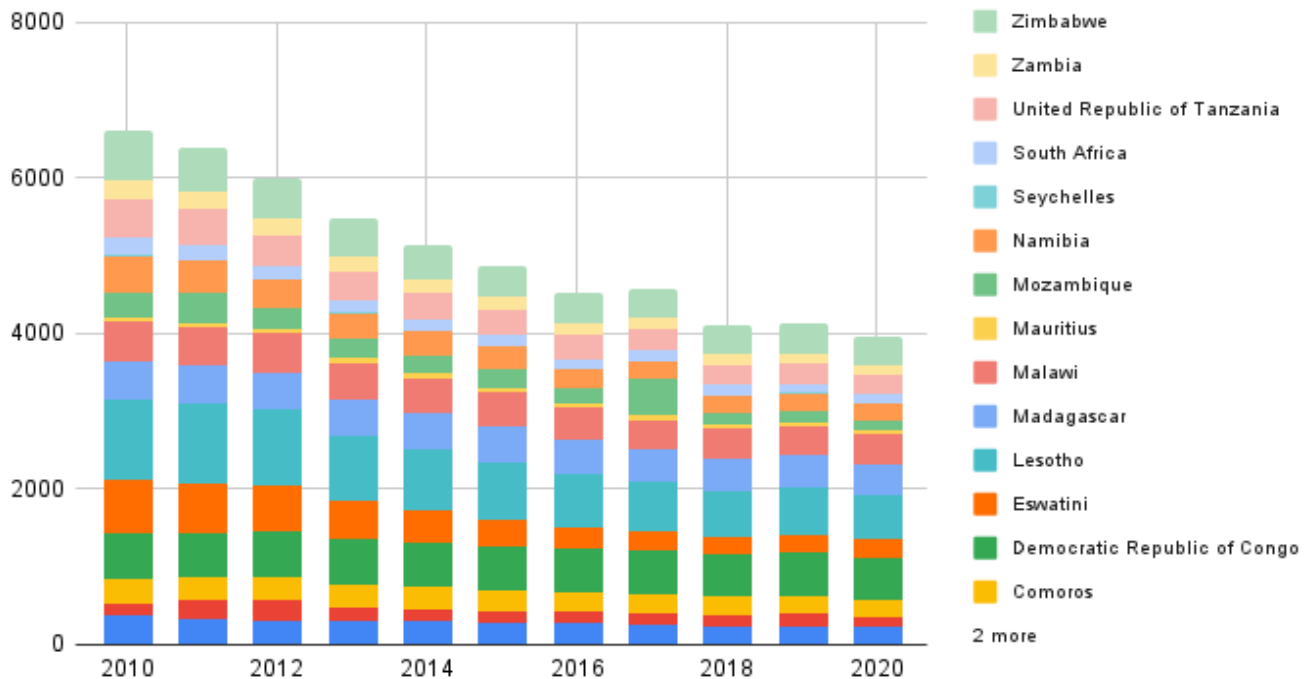


Figure 2: SADC Maternal Mortality Ratios (Source: SADC Data Portal 2025)

From the diagram above, Mozambique's maternal mortality ratio (MMR) decreased significantly from 322 deaths per 100,000 live births in 2010 to 127 in 2020, indicating a reduction of 60.5%. Namibia's MMR dropped from 653 deaths per 100,000 live births in 2010 to 344 in 2020, reflecting a decrease of 47.3%. In Zimbabwe, the MMR declined over the decade from 618 deaths per 100,000 live births in 2010 to 357 in 2020, representing a decrease of about 42.3%. Although Zimbabwe has made substantial progress in reducing its MMR, it still remains well above the SDG target.

Section 29 of the Constitution of Zimbabwe Amendment (number 20) emphasizes that the State must take all practical measures to ensure the provision of basic, accessible, and adequate health services throughout Zimbabwe (Constitution, 2013). The Government of Zimbabwe is committed to achieving this, as demonstrated by the implementation of various health strategies that include financing mechanisms aimed at improving health outcomes in Zimbabwe. Since independence in 1980, Zimbabwe's health system has undergone significant transformations. Initially, the country

made substantial progress in enhancing access to healthcare, including maternal health services. Economic instability, structural adjustment programs, and the HIV/AIDS epidemic in the late 20th and early 21st centuries significantly weakened the health system, leading to a decline in service delivery and infrastructure.

After Zimbabwe adopted the Sustainable Development Goals in 2015, the Ministry of Health created the National Health Strategy, which provided a framework to guide the ministry's efforts and those of its stakeholders in achieving the Zimbabwe Agenda for Socio-Economic Transformation and Agenda 2030 (National Health Strategy for Zimbabwe 2015). This strategy aimed to address issues related to maternal and child health service coverage and the quality of services provided. It also focused on adolescents and young people, who contribute significantly to maternal deaths. Furthermore, the strategy sought to decrease maternal mortality from 614 to 300 by 2020.

In Zimbabwe, maternal health services are supported through various sources, including government funding, donor contributions, out-of-pocket expenses, and health insurance. The Government of Zimbabwe allocates health funding through the National Budget, which is influenced by several National Development Strategies. Priority is given to ensure universal access to health services by providing quality care, which encompasses medications, trained personnel, and a conducive working environment.

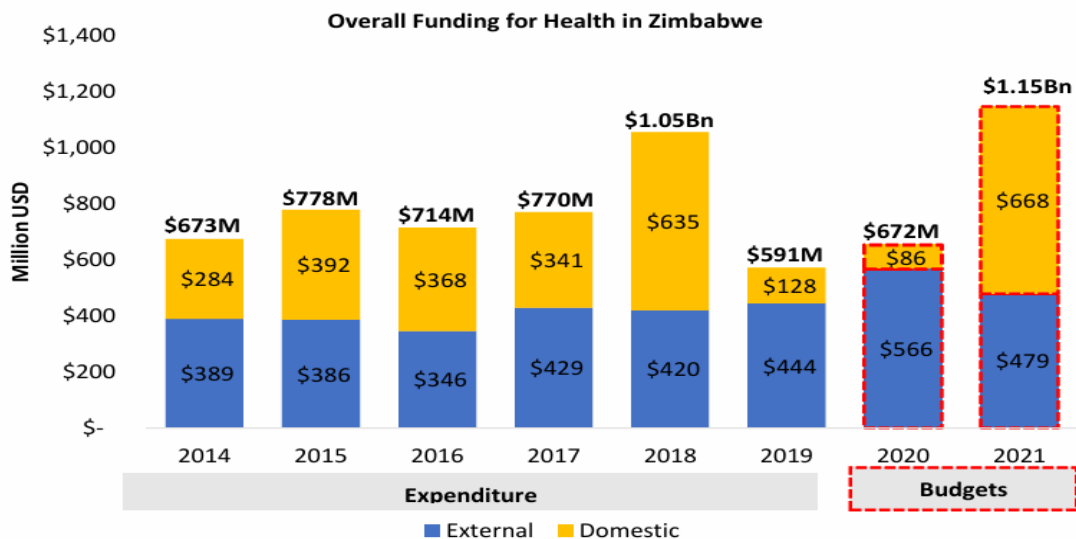


Figure 3: Overall Funding for Health in Zimbabwe (source: Health Sector Resource Mapping 2023)

Zimbabwe Maternal Mortality Ratio 2014 -2022

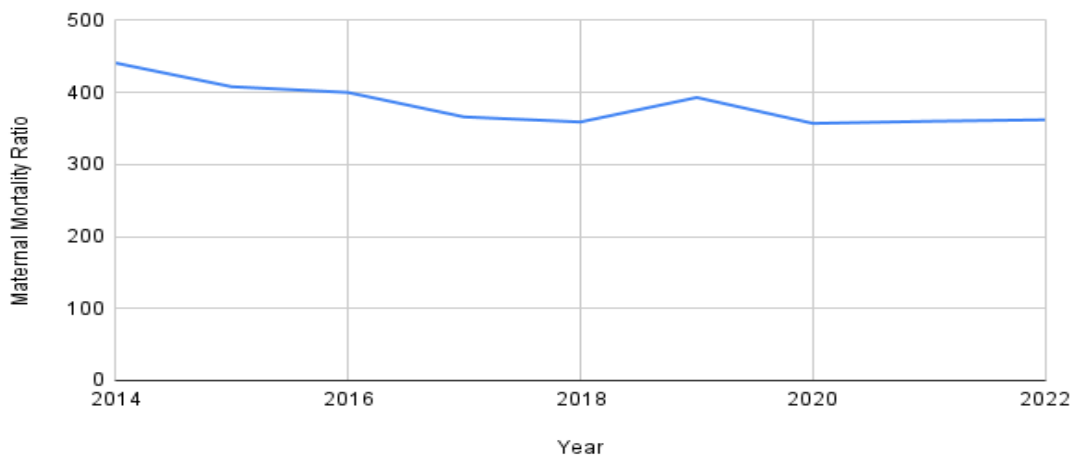


Figure 4: Zimbabwe Maternal Mortality Ratio (source: SADC data portal)

Health financing is gradually increasing, helping to address some of the issues behind high maternal mortality rates. Although funding for health has gone up since 2018, ongoing challenges in providing adequate maternal healthcare still remain in Zimbabwe. The diagram shows that funding for health peaked in 2018, even as maternal mortality rates continued to rise.

The National Development Strategy 1, 2020, stresses that improving health is key to happiness, well-being, and economic growth, as healthy populations tend to live longer, are more productive, and save more money. In 2023, the government allocated 11% of its budget to the health sector, receiving \$408.3 million in the first nine months of the year. This funding was directed toward areas like maternal health, newborn, child, adolescent, and reproductive health (Zimbabwe Budget Statement 2024).

In 2024, Zimbabwe also received development assistance totaling US\$353.77 million for the period of January to September 2024 (Zimbabwe Budget Statement 2025). International donors have played a significant role in supporting Zimbabwe's health sector, particularly in maternal health. However, reliance on donor funding is becoming unsustainable and is subject to fluctuations. Given the inconclusive relationship between health expenditure in Zimbabwe and maternal mortality, the bulk of the expenditure is donor-funded, which has significantly decreased due to the US executive orders.

1.3. Problem Statement

Maternal Mortality has significantly reduced from 618 deaths per 100,000 live births in 2010 to 357 in 2020, but remains the country with the highest MMR compared to Southern African Countries such as Mozambique (127) and Namibia (344). Most of the Maternal deaths could be prevented, thereby saving the lives of mothers and babies. The government and its partners are committed to addressing the high maternal mortality rate, indicated by the increase in funding for the health sector, with 2018 receiving the highest funding (Health Sector Resource Mapping report, 2023). Despite an increase in budget allocation and donor support in 2018, \$1.05bn, compared to the other years, MMR increased in 2019 and then began to decline. In 2016, when a smaller budget was allocated, MMR decreased. The evidence shown above shows an inconclusive relationship between health expenditure and MMR. The researcher seeks to understand if health expenditure reduces maternal mortality. Understanding the complex interplay between health financing mechanisms and maternal health outcomes is crucial for developing effective interventions and achieving sustainable reductions in maternal mortality.

1.4. Research Objectives

1. To examine the relationship between health expenditure and maternal mortality in Zimbabwe.
2. To identify the relationship between access to healthcare and maternal mortality in Zimbabwe.
3. To assess the relationship between healthcare workforce density and maternal mortality ratio in Zimbabwe.
4. To examine the relationship between maternal mortality and control variables (Education) in Zimbabwe.

1.5. Research Questions

1. How does total health expenditure relate to maternal mortality in Zimbabwe?
2. How does access to healthcare relate to maternal mortality in Zimbabwe?

3. What is the relationship between healthcare workforce density and maternal mortality ratio in Zimbabwe?

4. How does education and maternal mortality relate to each other in Zimbabwe?

1.6. Significance of the Study

1.6.1. To the institution

Researchers can use these findings to inform academic programs, making sure students get the latest, evidence-based information. This also helps create new knowledge and insights that improve our understanding of the complexities surrounding maternal mortality.

1.6.2. To the policymaker

The research will inform policymakers, ensuring decisions are grounded in empirical evidence. It also supports data-driven policy implementation, where policymakers advocate for government prioritization to intervene in areas of greatest need.

1.6.3. To the government of Zimbabwe

The research helps in identifying effective strategies to reduce maternal mortality, enabling the government to implement tailored programs. It also helps the government to allocate resources effectively by prioritizing areas with the most need.

1.6.4. To the existing board of knowledge

The research will address gaps in existing knowledge, providing new insights into the complex factors contributing to maternal deaths. It also refines theoretical frameworks and models, enhancing our understanding of the underlying causes and consequences of maternal mortality.

1.7. Assumptions

- Information collected will be accurate, complete, relevant, and can be relied on.
- Health spending is linked to maternal mortality.

1.8. Limitation of the Study

The study is limited to Zimbabwe, causing limited generalizability if one wants to carry out a regional study; however, the study provides the basis for future research for Regional analysis.

1.9. Delimitation of the study

The study is going to assess the relationship between Health Expenditure and maternal Mortality from 1990 to 2023 anything outside of observing the study between total health expenditure and Maternal Mortality within the period is not going to be covered.

1.10. Definition of terms

Maternal Mortality- is defined as death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes (World Health Organisation, 2022)

1.11. Chapter summary

This chapter outlines the key factors that drove the researcher to investigate how total health expenditure affects maternal mortality in Zimbabwe. It also lays out the research problem's objectives and questions. The chapter then addresses limitations and boundaries, and the next chapter examines relevant literature.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter covers a theoretical literature review, an empirical literature review, and identifies the research gap. The theoretical review sets the stage for understanding key concepts and theories relevant to the study. The empirical review examines research findings from other researchers within the existing body of knowledge, focusing on their methodologies, models, and the various dimensions they considered. The research gap analysis points out areas that need more investigation, guiding the direction and objectives of this study.

2.1. Theoretical Literature Review

2.1.1. Grossman's Health Capital Model (1972)

The Grossman Model (Grossman, 1972) posits that individuals demand health as a capital good. The model views health as a durable capital good that individuals invest in to increase their stock of health. Health expenditure is an input into the production of health, where an increase in expenditure can lead to increased access to healthcare services, which include prenatal care, skilled birth attendance, and postnatal care, all crucial for positive health outcomes. Health expenditure can influence the price and quality of healthcare services, making investments in maternal health more appealing (Grossman, 1972). Therefore, an increase in total health expenditure should result in a reduction in maternal mortality.

The demand for health is a derived demand. Individuals demand health not for its own sake, but for the benefits it provides, such as healthier days to work and earn income or to enjoy leisure activities and care for their families. Individuals are born with an initial stock of health that depreciates over time due to aging and other factors. This stock can be increased through investments in health inputs, such as medical care, diet, and exercise. Health expenditure directly influences the ability to invest in medical care.

Individuals combine various inputs, including medical care (influenced by health expenditure), time, and other goods and services, to produce health. Individuals will invest in their health as long as the marginal benefit of an additional unit of health capital exceeds the marginal cost. The

marginal cost includes the direct costs of healthcare and the opportunity cost of time spent seeking healthcare. The efficiency of this production process can be influenced by factors like education. A more educated mother might be more efficient at utilizing healthcare information and adhering to treatment plans. The theory also assumes that education has a negative relationship with maternal mortality. Higher levels of education result in reduced maternal mortality.

Increased public health expenditure can lower the price of maternal healthcare services, making them more accessible and affordable, thus increasing the demand for and investment in maternal health. Improvement in access to health care services improves maternal health. Investments in improving the quality of healthcare facilities and the skills of healthcare providers (funded by health expenditure) can increase the efficiency of the health production function, leading to better maternal health outcomes for a given level of input.

2.1.2. Becker's Human Capital Theory (1964)

Gary Becker viewed investments in education, training, and health as ways to enhance an individual's productive capacity. Healthy individuals are more productive, have lower rates of absenteeism, and can participate more fully in economic and social activities. Investments in maternal health, facilitated by adequate health expenditure, can lead to significant returns such as reduced maternal mortality and morbidity. This directly preserves women's productive years and reduces the burden on families and the healthcare system.

The theory says that healthy women participate more actively in the labor force, contributing to household income and economic growth. An increase in health expenditure contributes to the human capital of women by reducing morbidity and mortality. Therefore, health expenditure on maternal care can be seen as a crucial investment in human capital with long-term societal benefits. Increasing access to healthcare facilities enables more individuals to maintain their health, improving their ability to work, learn, and contribute economically.

Ensuring access to prenatal and postnatal care improves women's productivity and the health outcomes of the next generation. Healthy pregnancies and births contribute to the healthy development of children, impacting their future educational attainment and productivity. Healthy pregnancies and births contribute to the healthy development of children, impacting their future

educational attainment and productivity. Becker also acknowledges that a higher density of well-trained health workers reflects greater investment in healthcare human capital. A higher density of health workers enhances access to healthcare facilities and reduces barriers like long wait times and geographical limitations. This access directly correlates to better maternal and child health outcomes, as individuals can receive timely interventions. Therefore, from the Human Capital theory, we can deduce that improvement in health access improves the maternal health of women.

The theory is similar to the Grossmans' model in that investments in human capital and education yield returns in the form of higher earnings, improved health outcomes, and increased overall well-being. The theories are also similar in that they both talk about investing in the present to reap the benefits in the future. However, the two theories are different in that the Grossman theory mainly addresses health capital, viewing health as a durable stock that depreciates over time and can be replenished over time, whilst Becker's human capital theory focuses on education and training as investments that enhance an individual's productivity and earning potential.

2.1.3. The Production Function Approach (Arrow, 1964): Focusing on Inputs and Outputs

This theory views maternal health outcomes as the result of combining various inputs in a production process. Health expenditure is a key factor that influences the availability and quality of these inputs. The Production Function Approach provides a more granular view of how health expenditure translates into these improved outcomes. Increased funding allows for greater inputs into the "production" of maternal health (Arrow, 1964). Health expenditure fuels the availability and quality of these inputs, which are then combined to produce positive maternal health outcomes.

The inputs to maternal health production include healthcare services (prenatal care, skilled birth attendance), healthcare infrastructure (hospitals and equipment), healthcare professionals (doctors and nurses), public health interventions (immunization programs), and individual and household factors (women's education and nutrition status). These inputs are combined to produce maternal health outcomes, such as safe delivery, reduced complications, and maternal survival.

The efficiency of this process is influenced by factors like the organization of the health system, the quality of care protocols, and the skills of healthcare providers. The desired outputs are intermediate outcomes like access to timely care and the utilization of essential services. The

ultimate outcomes are improved maternal health indicators, such as reduced maternal mortality rates, lower rates of obstetric complications, and improved well-being of mothers. It's crucial to note that simply increasing expenditure does not guarantee better outcomes. The efficiency with which resources are used and the effectiveness of the interventions implemented are equally important. Factors like corruption, mismanagement, and lack of evidence-based practices can limit the impact of health spending.

The production function theory is similar to the Grossman model and Becker's human capital theory in that all three frameworks treat health as an investment. Each theory argues that investing in health today reaps dividends in the future. Improved health leads to better labor force participation, higher productivity, and lower incidences of adverse outcomes such as maternal mortality. The future benefits justify the current costs, reflecting a central feature of both capital investment and production theory. All three approaches recognize that health expenditure is a critical input into the production of health. Increased investments in health services improve the quality and accessibility of care. However, the Production Function Approach frames health outcomes as a result of a production process using multiple inputs. It also focuses on the efficiency and effectiveness of how inputs are transformed into outputs.

2.1.4. Equity and Access Theories: Addressing Disparities (Sen, 1999).

The theory emphasizes the broader benefits, equity, and access theories remind us that the positive impacts of health expenditure on maternal health must reach all women, regardless of their socioeconomic status or geographic location (Sen, 1999). The theory emphasizes that health services and resources should be distributed based on need, not socioeconomic status or geographic location. Increased public health expenditure can be strategically directed to reduce financial barriers through subsidies or universal healthcare initiatives. It can also fund the strengthening of healthcare infrastructure in underserved communities, ensuring that quality maternal care is geographically accessible. Health expenditure is also a driver of access. Public investment can reduce out-of-pocket expenses through subsidized services or universal health coverage programs, which make care more affordable.

Addressing socio-cultural barriers through community health programs, also supported by health expenditure, can further enhance equitable access and utilization of services. Without a focus on equity, the benefits of increased health expenditure may disproportionately accrue to more privileged populations, exacerbating existing health disparities (Whitehead, 1991). The theory adds to the notion that health is not simply a state of being but rather a resource that requires investment. The theories agree that different inputs, such as health expenditure, human capital, or social policies, are critical to producing better health outcomes. However, the equity and access theories focus on ensuring that all individuals have equal access to the capabilities that enable them to lead a healthy life. The theory uses ethical analysis to evaluate whether investments in health result in fair and just outcomes across populations rather than concentrating solely on efficiency.

2.1.5. Institutional and Governance Theories (North, 1990)

This theory provides the overarching framework that determines the effectiveness of health expenditure in achieving the goals outlined by the other theories. Even if there is sufficient funding and a clear understanding of the human capital benefits and the need for equitable access, poor governance can undermine these efforts (North, 1990). Inefficient allocation of resources, corruption within the health system, lack of policy coherence, and weak accountability mechanisms can all hinder the translation of health expenditure into tangible improvements in maternal health outcomes.

Coherent and evidence-based health policies are necessary to guide the effective use of resources. The capacity of government institutions to implement these policies and monitor their impact is also critical. Strong institutions, transparent financial management, and effective policy implementation are essential to ensure that health expenditure truly translates into better maternal health for all women (Ostrom, 1990). Mechanisms to ensure that healthcare providers, health system managers, and policymakers are accountable for maternal health outcomes and the use of public funds can drive improvements. Transparency in health budgeting and expenditure can also enhance public trust and participation. A stable political environment and good governance practices create a conducive environment for effective health policy and resource management.

All the theories above fundamentally treat resources, whether personal effort, financial expenditure, or institutional input, as investments that yield returns over time. Each theory is concerned with the efficient conversion of resources into desirable outputs whose benefits accrue over time. However, the institutional and governance theory concentrates on the broader institutional environment that shapes economic and health-related outcomes. It utilizes historical, comparative, and political economy analyses to examine how institutional arrangements impact economic performance.

2.2. Empirical Literature Review

Amwonya D. et al. (2022) conducted a study on the relationship between female education and maternal healthcare utilization in Uganda. The study used a cross-sectional design in a Sub-Saharan African country. It aimed to determine if increasing women's education leads to better health outcomes by analyzing a policy change that introduced free primary education. The study found that access to maternal healthcare is crucial for various health outcomes, including maternal morbidity and mortality, childcare, infant mortality, fertility, and life expectancy. To predict years of schooling, the researchers used Ordinary Least Squares (OLS) in the second stage model. They also employed a Regression Discontinuity Design (RDD) model, using birth years as a running variable, to examine the impact of education. To account for regional heterogeneity in the second stage model, they used a fixed effects model. The study concluded that female education has a positive effect on maternal healthcare utilization. The findings suggest that the longer a woman spends in school, the better her chances of achieving a positive maternal health outcome. This study is similar to the current one, as it assesses the impact of education on maternal health. However, it differs in terms of scope, focusing on Sub-Saharan countries rather than maternal health and female education in Zimbabwe.

Bang and Oh (2020) shed light on the crucial relationship between health expenditures and infant mortality, drawing insights from a comprehensive analysis of 100 countries over 18 years (2000-2017). The researchers employed a fixed effects model validated through the Hausman Test, revealing a notable negative correlation between increased health spending and lower infant mortality rates. Interestingly, the diminishing returns from health expenditures were particularly pronounced in developing nations, especially within Sub-Saharan Africa. The findings suggest

that targeted investments in the most vulnerable populations could lead to significant improvements, but to sustain these gains, countries must consider increasing their health budgets and fostering coordinated efforts across multiple agencies.

The study resembles the one conducted by Amwoya et al. (2022) in that it examined panel data, analyzing the effects across several countries while employing a fixed effects model to control for heterogeneity among those countries. However, the articles differ in that Amwoya et al. focused on education as a driver of health access and decisions, while Bang and Oh centered their study on the fiscal aspect of health interventions. Bang and Oh's study is similar to the current study in examining the impact of health expenditure. However, their study differs from the current study as they employed panel data and different methodologies.

According to Girum and Wasie (2017), their article explored the factors linked to maternal mortality in developing countries, covering 82 countries in an ecological study. The research looked at socioeconomic, health, and disease burden indicators, as well as maternal mortality rates, in these countries. The 82 countries included 31 low-income and 51 lower-middle-income countries. The researchers drew on international health databases from 2008 to 2016 for their ecological study. To fill in missing data, they developed a multilevel regression model using national-level data from surveys, censuses, surveillance systems, and death records.

The regression model included national income per capita, the general fertility rate, and the proportion of births attended by skilled attendants as covariates to predict trends in maternal mortality. Among the socioeconomic variables, GNI per capita and adult literacy rate were significantly negatively correlated with MMR, while early marriage showed a significant positive correlation. Skilled delivery service coverage had a strong negative correlation with the outcome variable, while total fertility rate per woman and crude birth rate exhibited a strong positive correlation with MMR.

The research is similar to the other studies as it also focuses on improving the health of mothers and infants by exploring how different inputs, such as education, health spending, or broader socioeconomic factors that affect key maternal and child health outcomes. They also argue that inputs beyond direct medical care, such as education and expenditures, are influential in driving better maternal and child health. However, Girum and Wasie use the maternal mortality ratio as the primary outcome and explore how factors like income per capita, literacy, fertility rates, and

skilled birth attendance influence maternal deaths. The study concentrates on 82 developing countries, thus emphasizing the ecological correlations at a broader international level rather than within a single country. Their study is similar to the current study assessing maternal mortality in developing countries, births attended by skilled health workforce, but it also included fertility rate which is not in the current study.

Researchers led by Rosser J in 2022 investigated the link between the number of healthcare workers, such as physicians and nurses/midwives, and the use of key maternal health services in sub-Saharan Africa (SSA). The study matched data on individual-level maternal health services from Demographic and Health Surveys between 2008 and 2017 with country-level data on the number of healthcare workers per person. This was done across 35 SSA countries. The researchers used univariate and multivariate probit regression analyses to examine the relationship between the number of healthcare workers and facility births, as the primary outcome, and additional prenatal care services, as secondary outcomes. They accounted for established factors that affect maternal health, including literacy, child marriage, difficulties accessing healthcare, GDP per capita, political instability, and government effectiveness. In SSA, the number of healthcare workers was low, with 0.13 physicians and 0.91 nurses/midwives per 1,000 people, compared to the global averages of 1.33 and 3.07 physicians and nurses/midwives per 1,000 people, respectively, in 2010. The study found that for every additional physician per 1,000 people, the likelihood of a facility birth increased by 9.8% (95% CI: 2.1–17.5%), and for every additional nurse/midwife per 1,000 people, it increased by 8.9% (95% CI: 7.1–9.7%). The number of healthcare workers was also associated with a higher likelihood of prenatal care from the respective provider type and with testing for preeclampsia, including urine and blood pressure checks. However, other prenatal care services showed variable relationships with the number of healthcare workers, depending on the provider type. In 35 SSA countries, the number of healthcare workers was positively associated with several key measures of maternal health service utilization, including facility births and prenatal testing for preeclampsia.

Another study with similar elements examines factors that impact maternal and child health. Both studies use econometric analysis with secondary data, control for confounding variables, and apply fixed effects to account for regional or country-level differences. They share a common goal of improving maternal and child health in resource-limited settings. However, Rosser et al. focused

on evaluating the effect of physician and nurse density on maternal service use. Like the current study, they assess how health workforce density and access to healthcare impact maternal health. However, the studies differ in their methodologies and use of panel data.

Tukay et al (2021) did an evaluation of the Direct Health Facility Financing Program in improving Maternal Health services in Pangani District, Tanzania. The study used both qualitative and quantitative methods, including 16 in-depth interviews with council health teams, facility in charge, maternal nurse in charge, and focus group discussions with community health governing committee members. The number of deliveries that occurred in the health facilities as well as medical supplies and equipment, were compared using descriptive statistics. The evaluation found that direct disbursement to the primary health care facilities reduced delays in procurement, improved community outreach services, and improved community leaders' engagement.

Researchers Rudasingwa M et al. (2022) examined the impact of universal health coverage on low-income populations in Zambia. Their study used a quasi-longitudinal benefit incidence analysis to investigate how public and overall health spending affected different income groups between 2006 and 2014. By combining data from household surveys and National Health Accounts, the researchers found that public health spending on curative services benefited poorer segments of the population, while spending on institutional delivery mostly benefited those with higher incomes. The study also highlighted inequalities in accessing higher levels of care for both curative and institutional delivery services. This research aligns with the current study's focus on how health financing affects health outcomes, and it builds on earlier studies emphasizing the importance of health financing in improving maternal health. However, the Zambian study's exploration of inequalities is a unique aspect not covered in the current study.

According to Lukwa, A.T. et al. (2022), a study on maternal socioeconomic inequalities in Zimbabwe found that some women were left behind. The research used the 2015 Zimbabwe Demographic Health Survey (ZDHS) and applied principal components analysis to estimate household economic status. Binary logistic regressions were then run to examine the relationship between maternal health services (including skilled birth attendance, antenatal care, and postnatal care) and demographic characteristics. Concentration indices were used to measure socioeconomic inequalities in maternal health service use, and the Erreygers decomposable concentration index helped identify the factors contributing to these inequalities in Zimbabwe. The

study found that overall maternal health utilization was high, with 93.63% of women receiving skilled birth attendance, 93.63% receiving antenatal care, and 84.27% receiving postnatal care. However, residence status played a significant role in antenatal care, with rural women 2.25 times more likely to use it. Wealthier women were less likely to use skilled birth attendance services compared to those from the poorest households. In contrast, women from middle-income and richest households were more likely to use antenatal care services. The study revealed that maternal health utilization in Zimbabwe was pro-rich, favoring women from wealthier households. Wealthier women were more likely to be assisted by a doctor, while midwives tended to assist women from poorer households. Although the study shares similarities with the current research in terms of skilled birth attendance and healthcare utilization for maternal health improvement, it also considers residential status, which will not be included in this study.

2.3. Research Gap

Despite the substantial body of research examining the determinants of maternal health, significant gaps remain, particularly concerning specific countries, for example, Zimbabwe. While many studies have utilized panel data to analyze the relationships between maternal health and various socioeconomic and environmental factors, there is a need for a study that looks at the unique conditions of Zimbabwe. This study will focus on a holistic approach targeting total health and how it impacts maternal health. The total health expenditure is inclusive of public, private expenditure and out-of-pocket expenditure. The study will use the ordinary least squares method to analyze the impact of health expenditure on maternal health.

2.4. Chapter summary

The chapter examined theories such as the Grossman Health Capital Model, Becker's Human Capital theory, and the production function approach, highlighting the importance of investing in health. Conversely, the chapter provided an overview of empirical literature that aligns with the study's notion, validating the research gap. The following chapter will discuss the methodology to be employed by the study.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter will look at the methodology that was used by the researcher in this study. It will look at the specifics of the model, justification of the variables included in the study, carry on to diagnostic tests, and close with data types and sources.

3.1. Model Specification

The researcher used the Ordinary Least Squares method to estimate the coefficients of THE, ACC, HWD, and EDU to conclude their impact on maternal mortality in Zimbabwe for the period 1990-2023. The researcher adopted his model from Grossman's Health Capital Model (1972) views health as a durable capital good that individuals invest in to increase their stock of health.

3.1.1. Model Estimation

$$MMR = \beta_0 + \beta_1 HE + \beta_2 HA + \beta_3 HWD + \beta_4 EDU + \varepsilon$$

MMR: Maternal Mortality Ratio,

HE: Total Health Expenditure,

HA: Health Access,

HWD: Health Workforce Density,

EDU: Literacy rate,

β_0 : intercept or constant term,

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ / coefficients of the independent variables,

ε = error term

3.2. Justification of variables

During this study, Maternal Mortality Ratio was used as a proxy measure of Maternal Mortality.

3.2.1. Maternal Mortality Rate

The Maternal Mortality Ratio (MMR) is a critical indicator of maternal health. It's a standardized measurement that enables comparison between countries and regions. The Grossman model also stated the importance of investments in health expenditure can lead to increased access to health services, reducing maternal mortality. In this study, MMR serves as the dependent variable.

3.2.2. Health Expenditure

Total Health Expenditure is a key determinant of maternal health outcomes. Arrow 1964, in the Production Function, noted health expenditure as one of the inputs necessary in producing maternal health outcomes. Increased health expenditure can lead to investments in health infrastructure, which improves access to health. This will lead to reduced maternal mortality. Therefore, this variable is expected to have a negative relationship with MMR.

3.2.3. Health Access

The Equity and Access theories (Sen, 1999) underscore the importance of equitable access to health services. Improved access to health due to increased investments can reduce MMR. This variable is expected to have a negative relationship with MMR.

3.2.4. Health Workforce Density

Health workforce density is a critical factor in determining maternal health outcomes. Becker's Human Capital Theory (Becker, 1964) highlights the importance of investments in human capital through education and training of health professionals can lead to reduced maternal health outcomes.

3.2.5. Health Education

The Grossman Health Capital Model emphasize the importance of education in improving maternal health outcomes. Higher literacy levels enables women to understand health risks, prenatal care and medical care. Educated mothers are more likely to seek medical assistance during pregnancy and childbirth.

3.3. Data Collection Procedures

The researcher used secondary annual data from 1990 to 2023, extracted from the World Bank Development indicators; Health Nutrition and Population Statistics. Data was collected for the following variables Maternal Mortality Rate, Total Health Expenditure, Health Access, Health Workforce Density, and Literacy Rate.

3.4. Data Presentation and Analysis

Outlines the procedures undertaken to establish the relationship between health expenditure and maternal mortality, identify the relationship between access to healthcare and maternal mortality, assess the relationship between healthcare workforce density and maternal mortality ratio and investigate the relationship between maternal mortality and control variables in Zimbabwe.

3.4.1. Data Analysis

Analysis of the relationship between health expenditure and maternal mortality in Zimbabwe was done using Stata 14.

3.5. Diagnostic Tests

The researcher performed diagnostic tests that ensure validity of the model. The following tests were conducted the Augmented Dickey-Fuller Test, Autocorrelation, Heteroscedasticity, and Multicollinearity tests.

3.5.1. Heteroscedasticity

According to Gujarati (2003), heteroscedasticity is defined as the condition in which the variance of the errors in a regression model is not constant across observations. When the variability of the error term changes, it can lead to inefficiencies in the estimation process and cause the standard

errors of the parameter estimates to be biased, affecting the reliability of the inference based on the model.

3.5.2. Autocorrelation Test

Autocorrelation measures how similar a time series (or signal) is to a lagged version of itself. In simpler terms, it quantifies the degree to which past values of the series influence future values, detecting patterns like periodicity or trends within the data. The Durbin-Watson test statistic will be employed to test for serial correlation.

3.5.3. Normality Test

To assess for normality, a Jarque-Bera test shall be employed. The Jarque-Bera test assesses the difference between the skewness and kurtosis of the series and that of a normal distribution. This test will help determine whether the data deviates from normality. The test statistic will be calculated based on the differences in skewness and kurtosis. A significant result will indicate non-normality in the data.

H_0 - the data follows a normal distribution

H_1 - the data does not follow a normal distribution

3.6. Chapter summary

In this chapter, the researcher described how the study was carried out, beginning with the model specification, the diagnostic tests, the data source and type, and the justification of the variables. The model developed was expected to come up with an in-depth analysis of the impact of total health expenditure on maternal mortality.

CHAPTER 4: DATA PRESENTATION, ANALYSIS, AND DISCUSSION

4.0 Introduction

This chapter presents and analyzes data to assess the significance of various factors influencing the Maternal Mortality Rate (MMR) in Zimbabwe. It outlines the use of descriptive statistics, relevant statistical tests, and other data manipulation techniques. The findings are examined to conclude on MMR and the underlying factors affecting maternal health.

4.1. Descriptive statistics/ Summary statistics

Table 1: Summary Statistics (source own estimation using stata 14)

Variable	MMR	THE	HA	HWD	EDU
Mean	452.7353	7.971805	1.927331	0.0388707	82.78443
Max	685	10.47584	3	0.201	93.35812
Min	249	2.789751	0.5105	0.0544	70
Std Dev	107.3793	2.232434	0.590414	0.388707	5.95282
Obs	34	34	34	34	34

The average MMR was 452.72, THE was 7.97, HA was 1.93, HWD was 0.0388707, and EDU was 82.78. MMR has a high standard deviation, indicating that the dataset is dispersed over a wider range, which suggests more variability. The other independent variables have a small standard deviation, showing that the data is clustered. This means that the values in the dataset are closely grouped around the mean.

4.2. Diagnostic test

4.3. Heteroscedasticity test

A heteroscedasticity test was conducted, and the results obtained are presented in the table below.

Table 2: Breusch-Pagan-Godfrey test (source: own calculation)

Chi2 (1) = 0.97
Prob> chi2 = 0.3256

The Breusch-Pagan-Godfrey test was conducted to assess heteroscedasticity. The F-statistic was 0.3256 which is greater than 0.05, indicating that there is no heteroscedasticity making the findings from the results reliable.

4.4. Multicollinearity test

Table 3: Multicollinearity test (source: own estimation)

Variable	VIF	1/VIF
The	3.66	0.273
Edu	3.48	0.287
Hwd	1.68	0.595
ha	1.56	0.641

In the table above, multicollinearity is assessed using the Variance Inflation Factor (VIF) to determine whether the independent variables are closely correlated with one another. The VIF for all variables was less than 5, indicating there is no multicollinearity.

4.5. Auto-correlation test

Table 4: Auto-correlation test (source: own calculation)

Durbin-Watson d-statistic (5, 34) = 1.226591

The table displays a Durbin-Watson statistic of 1.226591, indicating positive autocorrelation in the residuals of the regression model.

4.6. Robust Standard Errors

Table 5: Robust Standard Errors (source: own calculation)

F (4, 29)	27.47	R-squared	0.7660
Prob > F	0.0000	Root MSE	55.412

The table above shows that the P value using robust errors is 0.0000, which is less than 0.05. This suggests that the findings are likely to be reliable. There was positive autocorrelation, which is why the regression was done with robust standard errors to interpret the regression results as a solution to autocorrelation as cited by Newey and West (1987). There was not much difference between the regression results and the ones with the robust standard errors.

4.7. Normality Test

Skewness/ Kurtosis tests for Normality

Table 6: Skewness/ Kurtosis tests for Normality (source: own calculation)

Variable	Obs	Pr (Skewness)	Pr (Kurtosis)	Adj chi2 (2)	Prob>chi2
Myresiduals	34	0.6536	0.4627	0.78	0.6785

The p-value of 0.6785 is greater than the 0.05 significance level; therefore, we fail to find evidence reject the null hypothesis indicating that residuals are normally distributed.

4.8. Model specification

The model has a high R-squared value of 0.7660, which indicates that it exceeds 60%. This implies that approximately 77% of the variations in maternal mortality are explained by the explanatory variables, while only 23% are attributed to the error term. The adjusted R-squared of 0.7337, which accounts for the degrees of freedom, further demonstrates that the model still adequately explains the variations in maternal mortality.

4.9. Regression results

The results obtained from the model estimation are summarized below, and the estimation was conducted using Stata 14

Variable	Coefficient	Standard Error	T- statistic	Probability
the	17.51012	8.267158	2.12	0.043
Ha	62.89074	20.41196	3.08	0.004
Hwd	-1394.945	321.8271	-4.33	0.000
Edu	-1.5295	3.023409	-0.51	0.617
_cons	511.9892	290.2644	1.76	0.088

$$\begin{aligned}
 \text{MMR} &= 511.9892 + 17.51012\text{THE} + 62.89074\text{HA} - 1394.945\text{HWD} - 1.5295\text{EDU} \\
 & \quad (1.76) \quad (2.12) \quad (3.08) \quad (-4.33) \quad (-0.51) \\
 & \quad (0.088) \quad (0.043) \quad (0.004) \quad (0.000) \quad (0.617)
 \end{aligned}$$

4.10. Interpretation of the results

4.10.1. Total Health Expenditure

Total health expenditure is statistically significant in explaining variations in the maternal mortality rate in Zimbabwe at the 5% significance level. The positive coefficient of 17.51 indicates a positive relationship, suggesting that higher health expenditure is associated with an increase in maternal mortality. Specifically, for each unit increase in total health expenditure, maternal mortality is estimated to rise by approximately 17.51.

This outcome might stem from a misallocation of resources. Expenditures in the health sector may not be adequately directed toward interventions specifically targeting the root causes of maternal deaths. Funds may be allocated to general infrastructure, administrative overhead, or non-communicable diseases, while critical maternal health services, such as emergency obstetric care and antenatal care, remain underfunded. Additionally, inefficiencies may exist within the health system. A portion of the total health expenditure could be lost to administrative costs, like delayed procurement or poorly implemented programs. The results are in line with the Production Function Approach (Arrow, 1964), which focused on the efficiency of health financing in order to obtain the desired outcomes.

4.10.2. Health Access

Health access emerges as a statistically significant predictor of maternal mortality in Zimbabwe at the 1% significance level. The positive coefficient of 62.89 indicates that an increase in the number of health facilities is associated with a rise in maternal mortality rates. Specifically, each additional health facility is linked to an estimated increase of 62.89 maternal deaths, a finding that appears counterintuitive.

This positive relationship may arise from deficiencies in the quality of care. Although the number of healthcare facilities may be increasing, these facilities often lack the essential equipment, medications, and trained personnel to deliver life-saving maternal services. In Zimbabwe, many facilities struggle to handle life-threatening complications, such as hemorrhage, and experience shortages of blood supplies, surgical equipment, and trained staff capable of performing cesarean sections or managing referrals.

Additionally, geographic and logistical barriers can contribute to this issue. Although facilities may be available, poor road networks, inadequate emergency transport, and long travel distances can delay or even prevent access during critical moments. While the number of health facilities may be high in rural areas, the uneven distribution within those districts still leads to limited access in resettlement areas. The negative impact is in line with Institutional and Governance Theories by North, 1990 which looked at issues that if health institutions are not properly managed increase in health financing would still result in negative outcomes.

4.10.3. Health Workforce Density

Health workforce density is a crucial determinant of maternal mortality in Zimbabwe, showing a statistically significant relationship at the 1% level. The negative coefficient of -1394.945 indicates that an increase in the density of skilled health personnel—especially those attending births—is linked to a considerable reduction in maternal mortality. Specifically, each unit increase in skilled workforce density results in an estimated decrease of 1394.945 maternal deaths. This finding

highlights the essential role that a well-distributed and adequately resourced health workforce plays in enhancing maternal outcomes.

Skilled health professionals contribute not only through direct clinical care during childbirth but also through preventive services, timely identification of complications, patient education, and effective referral systems. Their presence can significantly reduce the risks associated with pregnancy and childbirth, particularly in resource-limited settings. Therefore, strengthening the health workforce through training, equitable deployment, and retention strategies is essential for advancing maternal health and achieving sustained reductions in maternal mortality. The positive impact of health workforce density is similar with the findings from the study by Rosser J et al (2022), who did a study to evaluate the relationship between physician and nurse/ midwife densities and the use of key maternal health services in sub-Saharan Africa (SSA).

4.10.4. Education

Education is not a significant predictor of maternal mortality in this study. This finding suggests that awareness of maternal health issues and preventive measures may not be the primary constraint. Instead, the main challenges may be related to accessing healthcare services, such as timely attendance by skilled health personnel and the availability of medication. Even if individuals are knowledgeable about healthy practices, limited access to healthcare facilities and services can increase the risk of complications during pregnancy and childbirth, ultimately contributing to high maternal mortality rates. The distance to healthcare facilities and the availability of skilled healthcare providers may be more critical factors in determining maternal health outcomes. The results are similar to the study by Girum and Wasie (2017), who wrote an article on the correlates of maternal mortality in developing countries: an ecological study of 82 countries.

4.11. Chapter summary

In this chapter, diagnostic tests and interpretation of results were conducted, and the findings show that total health expenditure has a positive relationship with maternal mortality. Health workforce density and education have a negative relationship with maternal mortality; however, education is not significant.

CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

In this chapter, the researcher presents a detailed conclusion to the study, discussing possible policies to enhance the health sector, particularly maternal health, based on the study's findings. Finally, the chapter emphasizes potential areas for future research.

5.1. Summary

Maternal mortality in Zimbabwe declined from 618 deaths per 100,000 live births in 2010 to 357 in 2020, yet it remains the highest in Southern Africa, higher than Mozambique (127) and Namibia (344). Most maternal deaths could have been prevented. While government and donor investments in health have increased, maternal mortality is on the rise. Therefore, there is a need for methods to reduce the Maternal Mortality Ratio to the Agenda 2030 target of 70 per 100,00 births.

This study examined the relationship between several independent variables and maternal mortality rates. The results show that total health expenditure has a significant positive relationship with maternal mortality rates, indicating that increased expenditure does not necessarily translate to reduced maternal mortality. Similarly, health access was found to have a positive relationship with maternal mortality rates, suggesting that increased access to health facilities does not lead to decreased maternal mortality, possibly due to limitations in healthcare quality, such as a lack of medication or skilled personnel.

In contrast, health workforce density was found to have a significant negative relationship with maternal mortality rates, indicating that improvements in this area can lead to substantial reductions in maternal mortality. Notably, education was not a significant predictor of maternal mortality rates in this study, despite its expected negative relationship. Overall, these findings underscore the importance of targeted interventions, particularly in health workforce density, to effectively reduce maternal mortality rates.

5.2. Conclusion

Our study's main goal was to determine how total health spending affects the maternal mortality rate. We used an OLS model to achieve this goal. The results revealed a positive link between total health spending and maternal mortality. Based on these findings, the government should enact policies that encourage efficient resource use for maternal health.

The study also indicated that health workforce density is negatively related to maternal mortality in Zimbabwe. As the government increases the number of health personnel, this reduces maternal mortality. The study also concluded that health education is not significant in reducing maternal mortality. Health access significantly impacts maternal mortality; however, there is a need to improve the utilization of health facilities to reduce maternal mortality.

5.3. Policy Implications and Recommendations

Enhancing program-based budgeting to reduce maternal mortality. The government and development partners need to strengthen resource mobilization and control to ensure that the funds address the intended objective. Methods that could be employed include monitoring, audits, and re-fencing the funds so that it will not be easy to divert the funds toward other projects. The government should prioritize provision of devolution funds for building and constructing new clinics in rural areas.

According to Zimbabwe Voluntary Local Reviews, some mothers have to walk long distances to access health services. This is very common, especially in resettlement areas where social amenities are limited. The impact of this problem could be reduced by converting some of the council buildings in various districts to be used as clinics. There could also be construction of mothers' waiting homes so that those who travel long distances will have places to stay close by before and after they deliver.

In Zimbabwe there is the challenge of high brain drain of skilled health personnel. To solve this by retaining experienced retired nurses to work and assist in providing antenatal care rural areas.

The ministry of health can also increase the number of community health workers to disseminate information and provide solutions to communities.

The government needs to ensure that in each district, there is a health facility fully equipped to provide maternal health services and manage obstetric emergencies, including cesarean sections and blood transfusions.

5.4. Further Research

Although this study's findings and conclusions are informative, they shouldn't be seen as definitive for other researchers. Instead, they should inspire further investigation into how total health expenditure affects maternal mortality. There are also other factors not considered in this research that could significantly impact maternal mortality in Zimbabwe. Various research methods could be used, and additional studies could examine and compare changes over time and the effects of specific policies.

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Appendices

Appendix 1: Summary statistics

```
. summarize mmrl the ha hwd edu
```

Variable	Obs	Mean	Std. Dev.	Min	Max
mmrl	34	452.7353	107.3793	249	685
the	34	7.971805	2.232434	2.789751	10.47584
ha	34	1.927331	.590414	.5105	3
hwd	34	.1386676	.0388707	.0544	.201
edu	34	82.78443	5.95282	70	93.35812

```
.
```

Appendix 2: Heteroscedasticity

```
. estat hettest
```

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of mmrl

chi2(1) = 0.97

Prob > chi2 = 0.3256

Appendix 3: Multicollinearity

```
. vif
```

Variable	VIF	1/VIF
the	3.66	0.273167
edu	3.48	0.287250
hwd	1.68	0.594579
ha	1.56	0.640643
Mean VIF	2.60	

```
.
```

Appendix 4: Autocorrelation test

```
. estat dwatson
Durbin-Watson d-statistic( 5, 34) = 1.226591
.
```

Appendix 5: Normality test

```
. sktest myresiduals
Skewness/Kurtosis tests for Normality
----- joint -----
Variable | Obs Pr(Skewness) Pr(Kurtosis) adj chi2(2) Prob>chi2
-----|-----
myresiduals | 34 0.6536 0.4627 0.78 0.6785
.
```

Appendix 6: Robust Standard Errors

```
Linear regression
Number of obs = 34
F(4, 29) = 27.47
Prob > F = 0.0000
R-squared = 0.7660
Root MSE = 55.412
```

mmr1	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
the	17.51012	6.487872	2.70	0.011	4.240937	30.77931
ha	62.89074	14.01447	4.49	0.000	34.22792	91.55355
hwd	-1394.945	292.0367	-4.78	0.000	-1992.227	-797.6624
edu	-1.5295	2.557272	-0.60	0.554	-6.759708	3.700708
_cons	511.9892	228.159	2.24	0.033	45.35169	978.6267

```
. estat dwatson
Durbin-Watson d-statistic( 5, 34) = 1.226591
```

Appendix 7: Regression results

```
. reg mmr1 the ha hwd edu
```

Source	SS	df	MS	Number of obs	=	34
Model	291454.989	4	72863.7472	F(4, 29)	=	23.73
Residual	89045.2293	29	3070.52515	Prob > F	=	0.0000
				R-squared	=	0.7660
				Adj R-squared	=	0.7337
Total	380500.218	33	11530.3096	Root MSE	=	55.412

mmr1	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
the	17.51012	8.267158	2.12	0.043	.6018886 34.41836
ha	62.89074	20.41196	3.08	0.004	21.14359 104.6379
hwd	-1394.945	321.8271	-4.33	0.000	-2053.155 -736.7343
edu	-1.5295	3.023409	-0.51	0.617	-7.713065 4.654065
_cons	511.9892	290.2644	1.76	0.088	-81.66813 1105.647

Appendix 8: Data Series

Data for total health expenditure (THE), health workforce density (HWD), health access (HA), education (EDU)

YEAR	MMR 1	THE	HA	HWD	EDU
1990	422	7.985316	0.5105	0.132	70
1991	418.6	8.103912	0.666094	0.131	74.5
1992	415.2	8.222508	0.821688	0.1344	79
1993	411.8	8.341105	0.977281	0.1378	79.05609
1994	408.4	8.459701	1.132875	0.1412	79.11217
1995	405	8.578297	1.288469	0.1446	79.16826
1996	401.6	8.696894	1.444063	0.148	79.22435
1997	398.2	8.81549	1.599656	0.1438	79.28044
1998	394.8	8.934086	1.75525	0.1396	79.33652
1999	391.4	9.052683	1.910844	0.1354	79.39261
2000	388	9.171279	2.066438	0.1312	79.4487
2001	589	9.289875	2.222031	0.127	79.50479
2002	443	9.408472	2.377625	0.13825	79.56087
2003	534	9.527068	2.533219	0.1495	79.61696
2004	488	9.645664	2.688813	0.16075	79.67305
2005	533	9.764261	2.844406	0.172	79.72913
2006	558	9.882857	3	0.124	79.78522
2007	656	10.00145	2.626667	0.0892	79.84131
2008	685	10.12005	2.253333	0.0544	79.8974

2009	670	10.23865	1.88	0.0596	79.95348
2010	618	10.35724	1.85	0.12	80.00957
2011	562	10.47584	1.82	0.126	80.06566
2012	528	8.082884	1.94	0.081	82.80505
2013	495	6.917949	1.97	0.08	85.54444
2014	441	7.109403	2	0.082	88.28383
2015	408	8.132273	2.03	0.122	89.29869
2016	400	7.449827	2.06	0.177	90.31355
2017	366	7.466447	2.09	0.174	91.32841
2018	359	6.363583	2.12	0.179	92.34326
2019	393	4.670392	2.15	0.201	93.35812
2020	357	3.232802	2.18	0.195	92.63875
2021	321	2.954401	2.21	0.189	91.91937
2022	285	2.789751	2.24	0.201	91.2
2023	249	2.798975	2.27	0.194	90.48062

