AN EMPIRICAL ANALYSIS OF THE EFFECT OF FERTILITY ON MATERNAL HEALTH STATUS IN NAMIBIA

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ABSTRACT

The study examines the effect of fertility on maternal health status in Namibia. Cross-section data from the Namibia Demographic and Health Survey for 2013 was used. Firstly the study estimated the Zero-Inflated Poisson (ZIP) model to analyze the effect of socio-economic factors on fertility. Secondly, the Linear Probability Model (LPM) was employed to examine the effect of fertility on maternal health status. To account for possible endogeneity in the fertility variable in the maternal health status model, the Instrumental variable (2SLS) method was used. The use of contraceptive was used as an instrumental variable for fertility. Moreover, the study made use of Body Mass Index and the probability of a mother being underweight as proxies for maternal health status.

The study findings shows that age of the mother, mother's marital status, household size and proportion of contraceptive use to positively associate with fertility. On the other hand, urban residence, education and listening to the radio all proved to have a negative relationship with fertility. In the maternal health status model the study results shows that high fertility increases the women's body mass index and reduces the probability of a women being underweight. Furthermore, the study emphasizes the importance of family planning awareness programs for the country especially the use of contraceptives in order to control fertility. In order to control for and maintain maternal health, the study recommends the investment in maternal education, the promotion of family planning awareness programs and promoting female empowerment. Based on the limited empirical studies on maternal health status, fertility and mortality in Namibia, this study adds to the empirical evidence in this area and also creates room for further research on fertility and maternal health.

DECLARATION

I, **Dortea Amwaama**, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

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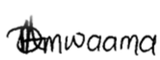

Signature April 2022

DEDICATION

To my mother Alina Amwaama, and my sister Loini Amwaama for their support prayers and encouragement.

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ABBREVIATION AND ACRONYMS

2SLS:	Two Stage Least Square
BMI:	Body Mass Index
CBR:	Crude Birth Rate
IV:	Instrumental Variable
IV Probit:	Instrumental Variable
LPM:	Linear Probability Model
MoHSS:	Ministry of Health and Social Services
NDHS:	Namibia Demographic and Health Survey
OLS:	Ordinary Least Squares
SSA:	Sub-Saharan Africa
TFR:	Total Fertility Rate
UNDP:	United Nations Development Program
UNICEF:	United Nations Children Fund
WHO:	World Health Organization
ZIP:	Zero-Inflated Poisson

CHAPTER ONE: INTRODUCTION

1.1. Background of the study

Healthcare is an essential input in health development (Edeme, Emecheta and Omeje, 2017). Health sector investment offers an opportunity for people to boost their health status. According to Edeme *et al.*, (2017), private spending on healthcare is dormant in developing countries and considered a major challenge in developing nations, this in turn causes infant mortality, communicable diseases, income poverty and inequality to remain high. Undertaking measure in health sector can have a long lasting and significant effect on the social and economic sector. Conversely, badly executed health measures can lead to disastrous effects. Therefore, it is of utmost importance that decision making in the health sector be imbedded with solid analytical skills and based on the best proven available information and knowledge (Dussault & Dubois, 2003).

Generally, an improvement in health and a reduction in mortality have been associated with a decline in fertility, an increase in human capital and economic growth. Improving maternal mortality reduces health cost of pregnancy and prolongs a woman's productive lifespan, which increases the return on human capital (Albanesi, 2012). In many developing countries, women of reproductive age account for about one fifth of the total population, and given inadequacy of medical and health facilities and current socioeconomic conditions, women in these nations are at great risk to mortality from causes related to pregnancy (Albanesi, 2012). To achieve the Sustainable Development Goals 3.1 of reducing the global maternal mortality ratio of 70 per 100000 live births, the need for countries to reduce their maternal mortality rate is critically important.

According to the World Bank (2017), there is a slow progress to the reduction of maternal mortality ratio in Namibia. Between the periods of 2007 (306 deaths per 100,000 live births) to 2017 (197 deaths per 100,000 live births), maternal mortality ratio in Namibia only declined by 36% (World Bank, 2017). As mentioned in the Sustainable Development Goal report the world is falling short on its promise to universal health coverage and does Namibia (United Nations, 2020). Due to high maternal mortality ratio, Namibia is nowhere near attaining or providing all individuals with full access to essential health services. Henceforth many mothers are still dying from preventable causes related to pregnancy. Therefore it is clear that quality of obstetric and neonatal care services are not optimal and the distance from a health facility hinders pregnant women access to essential health services (WHO, 2018).

1.2 Fertility trends in Namibia

Bongaarts (2020) shows that for the past century, many countries experienced remarkable decline in fertility trends. This is an exception to Sub-Saharan Africa (SSA) where population growth and fertility still remains high. The study further indicates that the SSA region is estimated to have a total fertility rate of 4.7 children per woman between the periods of 2015-2020, which is more than twice the average of other regions. World Bank (2018) shows that the world fertility rate was averaged at 2.47 children per women in 2013, while in Namibia it was at 3.6 children per women. This rate has declined from 4.2 children per woman in 2002. Although the country's total fertility rate is lower than SSA's average of about 5 children per women it is still above the replacement level of 2.1 children per women (MoHSS and ICF International, 2014). The replacement level is usually referred to as the amount of fertility needed in order to keep the population same.

According to the 2013 Namibia Demographic and Health Survey (NDHS), total fertility rate (TFR) in rural areas is higher (4.7 children per woman) compared to TFR in urban areas (2.9 children per woman). Moreover, the 2016 Namibia Inter-central Demographic Survey (NIDS) reports that the crude birth rate (CBR) in urban areas was 31.7 births per every 1,000 population while in rural areas it was 33.4 births per every 1,000 population (Namibia Statistic Agency, 2017). This pronounced difference between urban and rural fertility rates can be due to differences in socioeconomic characteristics of women, whereby rural areas tend to have less to none educated and unemployed women. More so, women in rural areas have limited or no access to family planning information and services, unlike women in urban areas. On the regional level, Kavango East and Kunene regions had the highest CBR with 45.5 and 43.7 births per every 1,000 population respectively (Namibia Statistic Agency, 2017).

The 2013 NDHS also indicates that women with no education had more than twice as many children as those with higher education (5.3 versus 2.2). The survey further reports on the fact that the proportion of women (in all age groups) who had given birth have declined over the past two decades. This is with an exception of 25-29 and 30-34 age groups. Fertility increased from 159 births per 1,000 women in 2006 to 168 births per 1,000 women in 2013 in the 25-29 age groups and from 145 births per 1,000 women in 2006 to 149 births per 1,000 women in the 30-34 age groups (MoHSS and ICF International, 2014). Figure 1.1 shows the trends of fertility rates in Namibia for the period 2000-2019

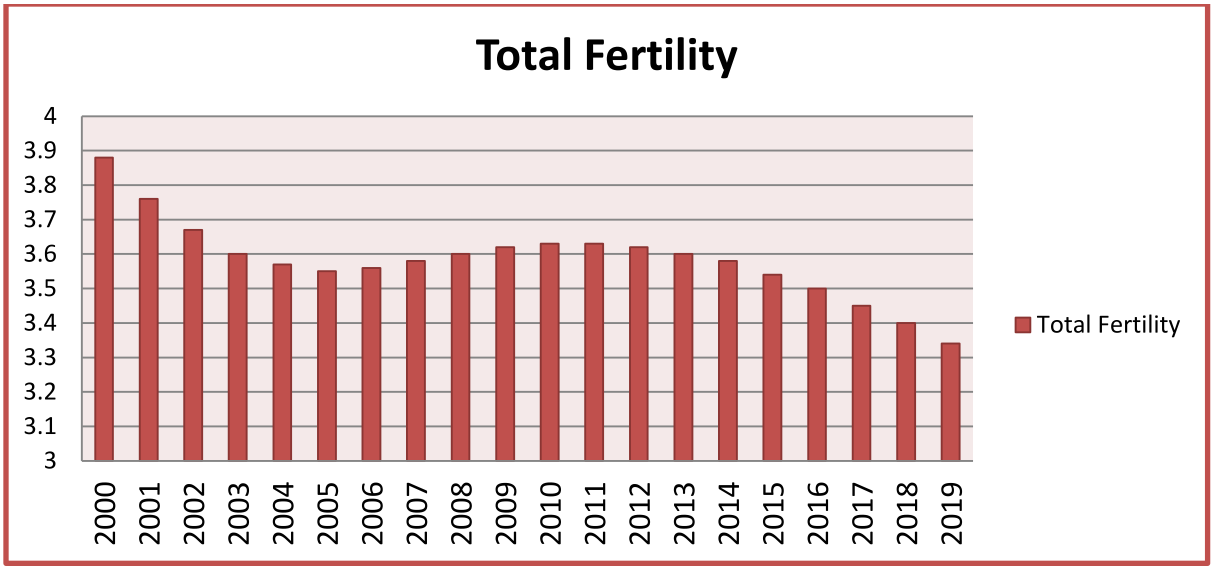

Figure 1.1: Total Fertility Rate in Namibia (2000-2019)

Despite the steady declining progress in fertility, evidence shows that about one third (33.3%) and more than one quarter (26%) of teenage girls aged 15-19 in Namibia had started childbearing by ages 19 and 18 respectively (MoHSS and ICF International, 2014). This is considerably high and troubling because children born to very young women tend to be at a great risk of sickness and death. Similarly teenage mothers are at increased risks of adverse pregnancy and maternal deaths.

1.3 An overview of Maternal Health in Namibia

The 2010 Panel Africa Progress Report discloses that a woman dies per minute in childbirth globally. More than 90% of these deaths occur in developing countries with almost half of them occurring in Sub-Saharan Africa. The Panel Africa Progress Report further states that, a woman in SSA region is at an increasing risk of dying while giving birth compared to a woman in another region. Over the years investing in health especially maternal health has become a crucial aspect for most governments. Investing in maternal health is a way to improve the health of mothers, because a healthy mother leads to healthy children, healthy societies and healthy economies (Panel Africa Progress, 2010).

The global maternal mortality ratio declined by 38% from 342 deaths to 211 deaths per 100,000 live births during 2000-2017 periods, translating into a 2.9% annual reduction between the periods of 2000-2017 (WHO, 2019). Namibia recorded a maternal mortality ratio of 285 deaths per 100,000 live births and 195 deaths per 100,000 live births in 2013 and 2017 respectively (World Bank, 2017). However impressive, this decline is less than half of the 6.4% rate needed to achieve the targeted Millennial Development Goal of 70 maternal deaths per 100,000 live births (WHO, 2019). Figure 1.2 shows trends of maternal mortality ratio for the period of 2000-2017.

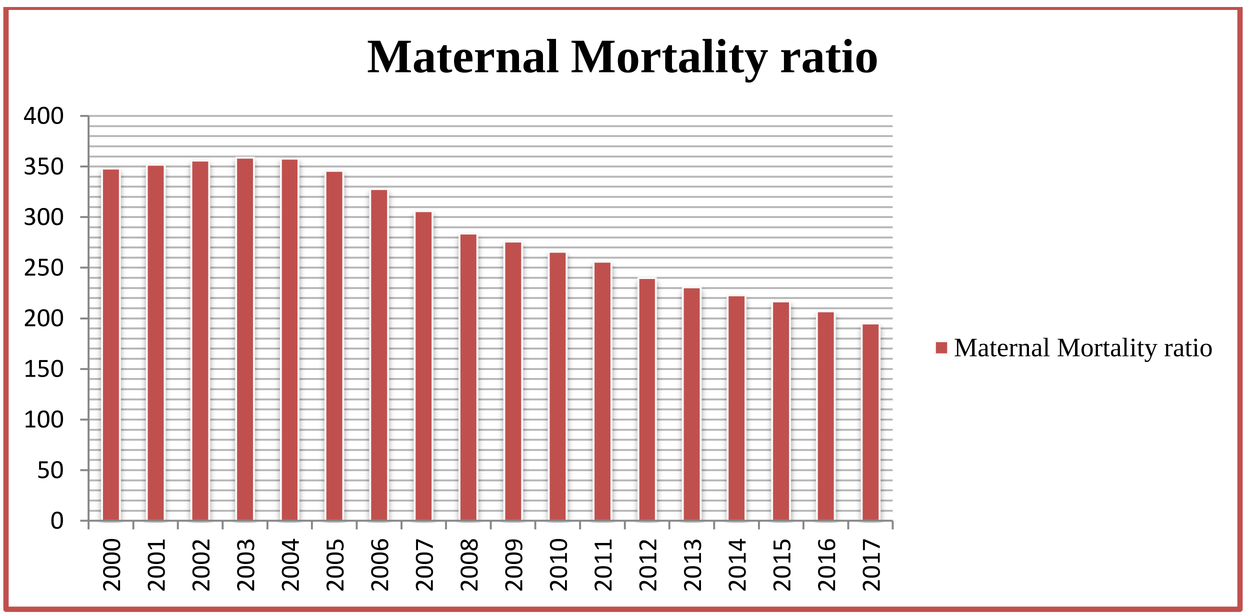

Figure 1.2: Maternal Mortality Ratio in Namibia (2000-2017)

In light of improving health status and welfare, the Namibian government implemented the national population policy aimed at reducing incidence of mortality and morbidity (Arowolo, 2000). In this regard, the national population policy was designed to focus mainly on the promotion of proper nutrition, adequate supplies of safe water, maternal and child care, basic household sanitation and health human resource development. More specifically, the policy focused on maternal health by strengthening the access to health services (especially for women living in distant communities) and recognizing and upgrading the skills of traditional birth attendance. Namibia being part of Sub Saharan Africa has been associated with high maternal mortality rate of 231 deaths per 100,000 live births according to the 2013 Namibia Demographic and Health Survey); this is due to human resources at lower levels of health care delivery services not being adequately equipped with skills to provide neonatal care services and emergency obstetric.

1.4 Problem statement

Maternal health is described as the women health during pregnancy, childbirth and postpartum period. Every year about 265,000 women die of causes related to childbirth and pregnancy in Africa (WHO, 2010). It is thus important for a country to reduce its maternal mortality ratio (Gupta, Singh & Kumar, 2016). In Namibia, maternal mortality ratio fluctuated between 348 per 100,000 live births in 2000 and 195 per 100,000 live births in 2017. However, the maternal mortality ratio has only been marginally reduced and the rate of decline is insufficient to attain Namibia's Vision 2030 targets of 50 per 100,000 live births in 2025 and 20 per 100,000 live births in 2030. Similarly, Namibia has been experiencing a reduction in total fertility rate between 2002 and 2017 from 3.8 to 3.4; however the rate of decline is not enough to achieve the goal of 2.0 in 2030 (WHO, 2009). Based on study conducted in Tanzania by Lihawa (2016), high fertility rates could be as a result of a decline in per capita household income and resources allocated to mother's health in terms of food intake and nutrition that may upsurge malnutrition (Lihawa, 2016).

Moreover, despite the fact that there is a decrease in maternal mortality ratio and fertility rate in Namibia, maternal mortality ratio and fertility rates are still high compared to the global maternal mortality rate of 211 deaths per 100000 live births and global fertility rate of 2.4 (WHO, 2019). The high fertility rates pose maternal health risks which results to poor health that impact negatively on productivity of mothers. Despite the maternal health being important and key indicators of fertility still being far from satisfactory, the available studies linking fertility and maternal health are missing in Namibia. Most of the studies in Namibia have focused on the determinants of fertility (Palamuleni (2017), Indongo and Pazakawamba (2012) whereby Mulama (2015) focused on the causes and risk factors associated with maternal deaths. These studies have ignored the link between fertility and maternal mortality. In regard to the first objective current studies mainly focused on Bongaarts Proximate determinants of fertility (Marriage, postpartum infecadability and abortion). There is a need to expand the proximate determinants of fertility in order to realize further fertility decline. Hence the current study will include more determinants such as household size, employment status and the use of contraception (instead of the proportion of contraception)to in order to improve the results.

1.5 Objectives

The general objective of the study is to analyze fertility and its effect on maternal health status in Namibia. Specifically, this study aim to:

a) Determine the effect of socio-economic factors on fertility in Namibia.

b) To analyze the effect of fertility on maternal health in Namibia.

1.6 Hypothesis

Hypothesis 1

H_0: Socio-economic factors have no effect on fertility in Namibia.

H_1: Socio-economic factor have an effect on fertility in Namibia.

Hypothesis 2

H_0: Fertility rate does not affect maternal health status,

H_1: Fertility rate does affect maternal health status.

1.7 Significance of the study

Understanding maternal health and fertility in Namibia does not only have a bearing on population growth, but also on socio-economic and political well-being of the country. Hence, the study is important for policy makers in developing and implementing sound policies and achievable targets in order to improve the country's maternal health status, reduce fertility and at the same time improve the performance of the economy. Thus, understanding the nexus between fertility and maternal health will enable policymakers and stakeholders to design specific policies for improving the health status of its population. Also, understanding the factors behind the change in fertility will enable policymakers to develop evidence-based policies regarding population growth.

Based on the limited empirical studies on maternal health status, fertility and mortality in Namibia, this study adds to the empirical evidence in this area and also creates room for further research on fertility and maternal health. More so, the study will help researchers and potential students get a comprehensive understanding on the relationship between maternal health and fertility in Namibia. Most studies in Sub-Saharan Africa have shown that maternal health status is highly correlated with economic status of the mother. However, few studies have focused on the effect of fertility on maternal health status. Therefore, the findings of the study will assist in designing policies of the well-being of mothers and on the reduction of fertility rates in SSA countries.

1.8 Limitation of the study

The study is limited to the recent availability of secondary data, and thus the study has addressed this issue by utilizing the available micro data from the 2013 Demographic Health Survey.

1.9 Scope and Organization of the study

The study is based on secondary data obtained from the 2013 Namibia Demographic and Health Surveys. The study is organized in 5 chapters. Chapter one has provided the background information, problem statement and objectives of the study. Chapter two discusses and reviews the theoretical and empirical literature on fertility and maternal health in Namibia and around the world. Chapter three discusses the methodology and estimation methods utilized to address the objectives of the study. Chapter four presents and discusses the study findings. Lastly, Chapter five presents the summary of the results and conclusions and recommendations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction to Literature

This chapter presents the theoretical literature on fertility and health production functions and reviews empirical literature on fertility and maternal health. More specifically the theoretical literature looks at the quantity-quality model and the Grossman model of health production in order to explain the relationship between fertility and maternal health, while the study reviews empirical literature on studies on the determinants of fertility and the effect of fertility on maternal health studies especially in Sub-Saharan Africa. Finally, the chapter provides synthesis on the literature and further indicates the research gap that the current study intends to fill.

2.2 Theoretical Literature Review

2.2.1 The Quantity-Quality model

The quantity-quality model was developed by Becker in 1960 to relate the demand for children the parent's income and cost of having children. The model suggests that parents derive utility from the number of children (quantity) and the quality of children (which is usually determined by the amount spent on each child). According to Becker (1960) there appears to be a negative relationship between the quantity of children and the quality of children. Moreover, Becker (1960) assumes that children are a source of physical income/satisfaction to parents and thus are considered consumption goods. At times, children can provide money income making them production goods. More specifically in this model, Becker classifies children with cars, houses and machinery, the cost and satisfaction derived from children is the same as the one associated with houses, cars and machinery. The model further emphasizes on how the changes in income and relative prices explains fertility trends.

To account for the observed relationship between income and fertility, Becker introduced the child quality in his theory of fertility (Doepke, 2015). Becker (1960) mentioned that examples of child quality choices can be associated with separate bedrooms, whether the child is sent to nursery or private school, and basically how much the parents spend on the child. Becker stresses the fact that the income elasticity of the demand for children depends on whether the child quality or quantity responds more strongly to income changes and not merely on the quality dimension. Therefore, the model postulates that a high-income elasticity of child quality and a low-income elasticity of child quantity correspond with other consumer goods such as cars and houses. For instance when a household becomes wealthier they tend to buy a car of high quality instead of opting to buying more cars. Similarly, when a household becomes wealthier, it will opt to improve the quality of the child instead of having more children (quantity). It is on this basis that the model infers a low income elasticity of child quantity and a high elasticity of child quality (Doepke, 2015).

2.2.2 The Grossman model of Health production

Grossman (1972; 2000) developed the theory of demand for health based on the human capital theory. The human capital theory states that there is a positive relationship between a persons' stock of knowledge and his/her productivity in the market sector of the economy. The Grossman model treats health as a form of human capital where individuals derive both consumption and investment benefits. The theory is used to explain individual health status by deriving demand for health from the utility function (Grossman 1972). Formally the Grossman model is written as: $U_t = U(H_t, Z_t)$

Where, H_t is health and Z_t is the consumption of goods and services.

The model further exploits the distinction between health as an output and medical care as an input in the production of health. To account for the difference between health as an output and medical care as an input in its production, Grossman made use of the household production function model of consumer behavior. This model puts emphasis on the fact that market goods and services are inputs in commodities that yield utility and they do not carry utility on their own (in this case medical care).

Furthermore Grossman's theory identifies a crucial link between household production model of consumer theory and the theory of investment in human capital. In the Grossman approach it is assumed that the individual first chooses his/her level of health and then chooses his/her length of life, meaning healthy behaviors can lead to a longer life. Initially an Individual inherits stock of health which depreciates with age, but can be replenished with investment like medical care. Therefore, it is noted that the level of health is not exogenous, but depends on the resources an individual allocates to its production. It is by this that the Grossman model treats medical care different from other goods and services because the individual is not buying these goods and services but good health. The model identifies other inputs into health as; exercises, education, nutrition, and lifestyle choices (Grossman, 1972).

2.3 Empirical Literature Review

2.3.1 Determinants of Fertility

Bhasin *et al.*, (2009) investigated fertility, income, and poverty of households in Ghana making use of the Ghana Living Standard Survey data for 1998-1999. The Ordinary Least Squares (OLS) was estimated to examine the determinants of structural income. The study found consumption expenditure per adult to have a negative relationship with fertility, but a positive relationship was observed when consumption expenditure was treated as an endogenous variable. The study further found that younger women and men are more likely to have fewer children and an increase in education level tends to reduce fertility. The use of contraceptives was found to have a positive influence on fertility indicating that they were not used successfully. Moreover, fertility was found to have a positive relationship with income more, so a similar effect is observed when fertility is treated as an endogenous variable in the income model.

Namubiru (2014) examined the effect of household poverty on women's fertility and child nutrition status in Uganda. The study made use of the 2006 Uganda Demographic and Health survey data and the 2005/2006 Uganda National Household Survey. The OLS and Zero Inflated Poisson (ZIP) model were used to estimate the fertility model. In order to account for the endogeneity issue, an Instrumental Variable (IV) method was used. The study further made use of control functions to account for heterogeneity, and the wealth index was used as a proxy for poverty. The empirical results indicated that the longer a woman takes to get to a health and water facilities the lower her wealth status. This means that poorer households tend to have limited access to water sources and health facilities in Uganda. The study found a positive association between age and wealth index and fertility. Furthermore the study revealed that secondary and post-secondary education tends to negatively affect fertility. In addition, women with an education were found to be wealthier than those with no education. Marital status was observed to have an important role in determining fertility, as married women tend to have more children than unmarried women. On the coefficient of religion, Muslim women were found to have a higher fertility unlike their counterparts in Pentecostal/SDA/other.

Ayele (2015) investigated the determinants of fertility in Ethiopia, using data from the 2011 Ethiopian Demographic and Health Survey. The study tested the linear mixed model to determine factors that affect fertility of women in Ethiopia. The variable of interest was fertility (births in the last five years), while socio-economic, demographic, and geographic factors were used as independent variables. Based on the estimated results, the study found all socio-economic, demographic and geographic factors to have a significant effect on fertility for the last five years. More specific, the study found that women who had no education had higher fertility than women with an education and women who have better living standards tend to have fewer children. The study further found that fertility tends to decrease as the family size increases and women who live in rural areas have higher fertility compared to women residing in urban settlements. Based on these findings, the study concluded that areas where traditional economic and social systems are prominent have higher fertility levels.

Chola and Michelo (2016) used the Zambian Demographic and Health Survey for 2007 to analyze the proximate determinants of fertility in Zambia. The Bongaarts proximate determinants model was used for analyzing the determinants. This model quantifies the contributions of four proximate determinants, namely contraceptives, marriage, abortion and post-partum infecundity. The indices of the Bongaarts model were computed through the use of the Microsoft Excel. The study found that marriage and post-partum infecundity were the largest contributors to fertility reduction. The study further observed that in terms of education, an inverse relationship was observed; post-partum infecundability contributed more to fertility decline than marriage among women with no education, whereas among women with higher education post-partum infecundability contributed less than marriage towards fertility reduction. However, with contraceptive the impact on fertility decline, increased with both education and wealth. The study concluded that the reason marriage has the largest inhibiting effect is due to the increased proportion of married women using contraceptives in Zambia.

Ndagurwa and Odimegwu (2019) reported on the elasticity of marital fertility in three Sub-Saharan Africa countries. The study examined the Demographic and Health Survey data for Zimbabwe, Kenya and Rwanda using marital fertility (ASMFR) as the dependent variable. Furthermore, it included contraceptive use, post-partum infecundity, abortion, education, employment status, household socio-economic status and age group as independent variables. The study estimated a Poisson regression based-direct estimation technique, linear regression and Oaxaca-Blinder decomposition method to analyze the elasticity of marital fertility. The study found that all three countries experienced long term significant transformation in the characteristics of married samples. The study further found that Kenya and Rwanda experienced rebounds in fertility rates soon after periods of rapid falls of fertility rates. Post the rapid fall of fertility rates period, Zimbabwe, entered a period of slow decline of fertility rates. The decomposition results explains only a small proportion of changes in marital fertility, since the increases in employment, education and among other characteristics were mostly small leading to a not meaningful effect on ASMFR. Ndagurwa and Odimegwu (2019) concluded that some socio-economic factors do not necessarily explain the increase and decrease in marital fertility in Kenya, Rwanda and Zimbabwe.

Ewemooje, Biney and Amoateng (2020) studied the determinants of fertility intentions among women of reproductive age in South Africa using the South African Demographic and Health Survey data of 2016. The study compares specifically the childbearing intention of women 15-34 years to women of 35-49 years. The study used multinomial logistic regression and found that women's general intention for another child is significantly predicted by race, employment status, place of residence, level of education and parity for both age groups. More importantly, the results show that for both age groups; being black, having a secondary level education and being employed significantly influences general childbearing intentions. The study further found that the intention of having a/another child significantly increased with the younger women (15-34). The study affirms that the impact is stronger for younger women because older women who have achieved their desired family size have no interest in having any more children.

Kabede, Striessnig and Goujon (2021) examined the relative importance of women's education on fertility desires in Sub-Saharan Africa (SSA). The study used a combination of individual and community level data from the Demographic and Health Surveys in 34 SSA countries. The study limited its sample to the most recent survey of each country and categorized women's educational attainment into five levels: no formal education, incomplete primary education, completed primary education, some secondary education and completed secondary education or higher. A multilevel Poisson regression model was employed to assess the impact and found that older women tend to report a higher desire for more children. The ideal number of children for women who completed any level of education tend to drop in relation with those with no education. Similarly, women with higher wealth quintiles tend to desire less children unlike women in lower wealth quintiles. However, Kebede et al (2021) also found that the effect of education; fertility desires tend to be robust even when controlling for marital status and place of residence. This shows that in Sub-Saharan Africa the place of residence and wealth, fall short in explaining the relationship between women's fertility desires and education.

Ahinkorah *et al.,* (2021) analyzed socio-economic and demographic factors associated with fertility preferences among women of reproductive age in Ghana. The study used the Ghana Demographic and Health Survey data for 2014 to assess the association between fertility preferences and socio-economic status with fertility preferences being the outcome variable. The study further considered education, wealth, age, residence, occupation, region, ethnicity, parity religion and access to media as socio-demographic characteristics. The study used a bivariate logistic model to analyze the independent association between socio-economic and demographic factors and the desire to have more children. Furthermore, the study fitted a multivariate logistic model to examine demographic and socio-economic predictors of fertility preferences. The study found that women with higher education level and from the richest wealth quintile are less likely to desire more children. Ahinkorah et al (2021) suggest that females with low education level need to be educated on the importance of low fertility. Moreover, the study found that there exists a statistically significant relationship between regions of residence, religion, ethnicity and desires for more children. The study urges the adoption of various family planning strategies such as the use of contraceptives among women with low level of education.

Palamuleni (2017) and Indongo and Pazakawamba (2012) examined the trends in proximate determinants of fertility in Namibia. While Palamuleni (2017) analyzed the trends in the proximate determinants of fertility using the 1992, 2000, 2006 and 2013 Namibia Demographic and Health Surveys data, Indongo and Pazakawamba (2012) examined fertility trends and fertility differentials across sub-groups in Namibia using data from 1992, 2000 and 2006 DHS. Palamuleni (2017) made use of Bongaarts's framework of proximate determinants to explain factors contributing to fertility decline. The results show that the effect of marriage on fertility is more significant than any other determinant, followed by contraception with post-partum infecundability having the least significance. The results also show that the importance of contraceptive use has increase since 1992. On the other hand, Indongo and Pazakawamba (2012) made use of a multivariate analysis to estimate the effects of the determinants on fertility. The results of the study suggest that fertility among women in Namibia is associated with age at first intercourse, desire for more children and fertility preferences. Moreover, the study found that fertility increases by the age of the women and there is a significant relationship between women with at least secondary level education and fertility decline. Women with at least a secondary education have fewer children than women with no education; this scenario is similar among employed women.

2.3.2 The effect of fertility on maternal health status

Buor and Bream (2004) investigated the determinants of maternal mortality in Sub-Saharan Africa (SSA) using data from the World Bank and government statistical offices. To analyze the objectives a bivariate correlation and categorical cross-tabulation were used. The bivariate was used to test for the relationship and correlation matrices were used to find the association among variables. All dependent variables were cross tabulated with the dependent variable to determine significance. Based on the results, the study found that there exists a correlation between health expenditure per capita, GNP, female illiteracy, skilled attendance of delivery, life expectancy and maternal mortality. A strong correlation was observed between GNP and health expenditure per capita, and a significant relationship was observed between GNP, female illiteracy and total fertility rate. Moreover, the study found that maternal mortality had an inverse relationship with births attended by skilled health personnel. The results further show that socio-economic factor weight heavily against SSA. The study, however, recommended that, with direct intervention; skilled attendance, health expenditure per capita and literacy can improve, while total fertility rate can improve with educational, cultural and social intervention.

Bakhshi *et al*., (2008) looked at the association between number of children and obesity in Iranian women and men, by making use of data from the 1999-2000 National Health Survey. The study included men and women between the ages of 20-17, excluding pregnant women. The Generalized Estimating Equation (GEE) was used to estimate the odds of obesity (proxy by

BMI) given the number of children (fertility) and other explanatory variables. The study observed that the odds of obesity increased with the number of children emphasizing that women are more likely to be obese than men. The study further found that obesity increases with age in women and decreases in men. A negative relationship was observed between individual that work and women with lower education are more likely to be obese than their counterparts that have a higher education. The study concluded that couples with more children spend more time taking care of the children and has little time to spend on health behaviors.

Dahiya and Viswanathan (2015) investigate women's malnutrition in India focusing on the role of economic and social status. The study used data from the 2005-06 Human Development survey. The body mass index (BMI) was used to capture under nutrition and over-nutrition in women aged between 20-40 years. To assess the differential impact of the explanatory variable on body mass index a quintile regression model was used. The study found per capita income, wealth and per capita consumption expenditure to be significant in explaining BMI. Similarly, the results show individual, household, dietary, social infrastructure and women empowerment variables to be significant in determining BMI. The estimated results show that the dietary diversity index exhibits a negative relationship towards women's malnutrition, which means that women do not prioritize the importance of diets in India. Dahiya and Viswanathan (2015) further observed that social infrastructure such as access to good quality sanitation facilities; electricity and fuel had a positive relationship to BMI in women. Women dietary habits were observed to vary across religions, where Muslim, Christian and other religion had a higher BMI than women belonging to Hindu religion. An increase in BMI was substantial in women who fall in the rich wealth quintile indicating overweight and obesity. Additionally, the study found that mothers with children between 0-4 years had lower BMI than mothers with older children. Employment status of the mother was observed to have a negative relationship with BMI concluding that most women are likely to be involved in manual work.

Girum and Wasie (2017) conducted a study on the correlates of maternal mortality in 82 developing countries. The study used international databases of health metrics for the period of 2008 to 2016 by specifically making use of health indicator data from WHO, Word bank, UNDP and UNICEF. A multilevel regression model was developed with maternal mortality ratio as the outcome variable and explanatory variables were comprised of health and socio-economic indicators. The study observed that there is a correlation between a country's maternal mortality ratio and socio-economic, health indicators and disease burden indicators. Socio economic and health indicators were both found to having a significant correlation with maternal mortality ratio. The study found fertility to be an important determinant of maternal mortality, where high fertility is associated with high maternal mortality. An inverse correlation was observed between improved sanitation and safe water supply and maternal mortality rate in these countries. In the context of disease burden indicators, prevalence of anemia and incidence of Tuberculosis were found to be significantly correlated with maternal mortality ratio. However, the correlation between HIV incidence and maternal mortality was not significant.

Rosário *et al.,* (2019) examined the determinants of maternal health care and birth outcomes in Dande Health and Demographic Surveillance System area in Angola between 2009 and 2015. The study tested a logistic regression model to examine the determinants of birth outcomes, antenatal care attendance and place of delivery. Firstly, based on the findings of birth outcomes; women who gave birth at the mean age of 26.5 years were at risk of pregnancy related deaths. Women living in rural areas were at higher risk of delivering a still birth than women in urban settlements. Women with more years of education were found to have a low risk of delivering a stillbirth unlike women who had less years of education. Secondly, looking at antenatal care attendance, the study found that women residing in rural areas have a less chance of having antenatal care attendance compared to women in urban areas. Further, the odds of not attending and antenatal care visits increased with age and decrease with women who passed more years of education. An inverse relationship between number of children and antenatal care visits was observed. Finally, place of delivery was significantly associated with all explanatory variables.

Hamal *et al*., (2020) examined the social determinants of maternal health in India. The study adopted the CSDH framework to maternal health by intergrating the 1994 Thaddeus and Maine's three delay model and the 1992 McCathy and Maine's framework on distant and immediate determinants of maternal health. The study conducted a narrative integrative synthesis approach to summarize the intermediary and structural factors of maternal health. This approach found that ethnicity, economic status, gender and religion were the frequently structural factors associated with maternal health service use. Place of residence, higher concentration of wealth, education at community level and factors influencing accessibility of health services were the community related factors that influenced maternal health service use in India. The demographic factors found to influence the use of maternal health services were women's age at marriage, young age at childbirth and high birth order. Furthermore the study found that women living in rural areas, uneducated, of the Muslim religion, had childbearing at a young age, with low economic status and with two or more children are more likely no to seek maternal health services.

Mulama (2015) analyzed the causes and risk factors associated with maternal deaths in Namibia. The study made use of data based on health facility reviews of maternal records from the Ministry of Health and Social Services during the period of 2018-2012 and from the 2011

Namibia population and Housing census. To determine the relationship between variables of interest and maternal deaths, a bivariate and multivariate analysis were estimated. More specifically a logistic regression and unadjusted odd ratio and confidence interval were estimated to assess the risk of maternal mortality. Based on the results, the study found that the most common direct cause of maternal mortality in Namibia was haemorrhage. The study also found that maternal mortality varies in accordance to different age groups. High maternal mortality was found in the 20-24, 25-30 and 30-34 age groups. The study observed less maternal mortality ratio in urban areas compared to maternal mortality in rural areas. Moreover, the study found HIV to be the leading indirect cause of maternal mortality ratio in the country. On the risk factor side, the study found that women marital status, her age and place of residence were the risk factors associated with maternal mortality ratio. Furthermore, the study found that there was little difference between education and no educations in terms of their effect on maternal mortality in Namibia. Thus, the study concluded that there are other dynamics that play a more important role.

2.4 Synthesis of Literature

This chapter has explored both the theoretical and empirical literature related to the analysis of fertility on maternal health status in Namibia. The Quantity-Quality model reveals the importance of treating children as consumer durables such as houses or cars. The Grossman model reveals that an individual invests in his or her health based on the costs and benefits derived overtime. The quantity-quality model and Grossman model both provides methodologies that can link socio-economic determinants to fertility and approaches that analyze the link between fertility and maternal health. For instance, these theories provide insights on how countries can move from high fertility to low fertility and how to improve the health of women especially during and after pregnancy. The empirical literature reviews some studies on the determinants of fertility and some studies linking fertility to maternal health. Most studies reviewed were conducted in developing nations especially in the Sub-Saharan Africa region.

The empirical studies reviewed made use of multilevel/bivariate logistic regression, multilevel Poisson regression, Bongaarts proximate determinants model and LPM to assess fertility, its determinants and its effect on maternal health. Studies that made use of the Zero Inflation model (ZIP) are few meaning that most of these studies did not control for the issue of excess zeros. In the context of Namibia, Palamuleni (2017) and Indongo and Pazakawamba (2012) examined the trends in proximate determinants of fertility in Namibia and none of these studies accounted for excess zeros in the fertility variable. Additionally, Mulama (2015) analyzed the causes and risk factors associated with maternal deaths in Namibia. However, all the studies conducted in Namibia on fertility and maternal health only examined fertility and maternal health separately and no study specifically investigated the effect of fertility on maternal health status. Hence, little is known on the influence of fertility on maternal health status in Namibia. Therefore, this study uses a large and national representative sample size of 9,176 women and utilizes different econometric techniques (ZIP) that account for the excess zeros in the fertility data and LPM, adding to empirical literature on Namibia. In addition, studies linking fertility and maternal health especially using BMI are missing in the context of Namibia. This is the knowledge gap that this study intends to fill using data from DHS 2013 in Namibia.

CHAPTER THREE: METHODOLOGY

3.1 Introduction to Methodology

This chapter presents the methodology adopted in the study to analyze the effect of fertility on maternal health status in Namibia. The chapter outlines the research design, the theoretical framework and model specification, the definition and measurement of variables, data sources and data collection and finally the ethical practices adhered to.

3.2 Research Design

The research design for the study is quantitative in nature. Descriptive statistics and quantitative research techniques were employed using data obtained from the Namibia Demographic Health Surveys.

3.3 Theoretical Framework

The study adopts a similar but slightly modified method as that adopted in Lihawa (2016). Lihawa (2016) analyzed fertility and its effect on health among mothers and children in Tanzania focusing on 3 objectives: the effect of socio-economic factors on fertility, the effect of fertility on Child Health and the effect of fertility on maternal health status. The current study, however, only focuses on 2 objectives; the effect of socio-economic factors on fertility and the effect of fertility on maternal health status as guided by the theoretical framework. This study adopts the household utility maximization theory as presented by Rosenzweig and Schultz (1983) to formulate fertility and maternal health outcomes in Namibia.

The utility maximization theory specifies a simple model of household whereby utility is maximized based on the health/production function for maternal health and income constraints. The household utility model is expressed as:

$U = U(C, X, Y, Z, H_m)$……………………………………………………………..(3.1)

Where C is the number of children (fertility), X is the consumption of health neutral goods, Y is the consumption of the health-related goods, and Z is the health investment goods and H_m is the mother's health status (Maternal status).

According to Rosenzweig and Schultz model, the maternal health production function is a function of consumption of Y and Z goods and the unknown variable µ, which can be stipulated as:

$H_m = f(Y, Z, \mu)$………………………………………………………………… (3.2)

However, equation 3.2 only restricts the production of household health to only the consumption of household related goods (Y) and the health investment goods (Z), while there may be other factors that contribute to the health production of the household. Henceforth the study includes the number of children (C) and socio-economic characteristics (E). The modified household production function of maternal health status will be presented as:

$H_m = f(Y, C, E. Z, \mu)$……………………………………………………………… (3.3)

In this case, the household utility maximizes equation (3.1) with consideration of equation (3.3) subject to s budget constraint as follows:

$I = XP_x + YP_y + ZP_z$…………………………………………………………… (3.4)

Where, I is the household income and P_x P_y P_z are the prices of health neutral goods X, the heath related goods (Y), and the health investment goods (Z) respectively.

The utility maximization problem is then solved through the Lagrangian Function as follows:

$L = U(C, X, Y, H_m) + \lambda(I - XP_x - YP_y - ZP_z)$………………………………… (3.5)

The health production function is substituted into the utility function, rewriting the utility function as follows:

$L = U\{C, X, Y, \text{f}(Y, C, Z, E, \mu)\} + \lambda(I - XP_x - YP_y - ZP_z)$……………………… (3.6)

The differentiation of the Lagrangian function (3.6) yields the first order conditions (FOCs) for the household utility:

$\frac{\partial L}{\partial X} = U_x\{C, X, Y, \text{f}(Y, C, Z, E, \mu)\} - \lambda P_x = 0$………………………………………… (3.7)

$\frac{\partial L}{\partial Y} = U_y\{C, X, Y, \text{f}(Y, C, Z, E, \mu)\} * \text{f}_y(Y, C, Z, E, \mu) - \lambda P_y = 0$……………………… (3.8)

$\frac{\partial L}{\partial Z} = U_z\{C, X, Y, \text{f}(Y, C, Z, E, \mu)\} * \text{f}_z(Y, C, Z, E, \mu) - \lambda P_z = 0$………………………. (3.9)

$\frac{\partial L}{\partial C} = U_c\{C, X, Y, \text{f}(Y, C, Z, E, \mu)\} * \text{f}_c(Y, C, Z, E, \mu) - \lambda P_c = 0$………………………. (3.10)

$\frac{\partial L}{\partial \lambda} = I - XP_x - YP_y - ZP_z = 0$…………………………………………………... (3.11)

Since the study has not assumed any functional form for the health production and the utility function, there is no need to simultaneously solve the FOC to arrive at the demand function for X, Y and Z. See Chiang (1984) for the easier way to arrive at the expressions provided below:

$X = x(P_x, Py, Pz, I, E, \mu)$……………………………………………………… (3.12)

$Z = z(P_x, Py, Pz, I, E, \mu)$……………………………………………………… (3.13)

$Y = y(P_x, Py, Pz, I, E, \mu)$……………………………………………………… (3.14)

$C = c(P_x, Py, Pz, I, E, \mu)$ .... (3.12)

The study adopts the household utility maximization theory by Rosenzweig and Schultz (1983) to formulate the maternal health function. However, maternal health cannot be purchased from a market (Lihawa, 2016). In order to consume maternal health the household produce it using inputs expressed in equation (3.3). Furthermore, the reduced equation (3.12) will be estimated using the Zero Inflated Poisson (ZIP) in the fertility model.

3.4 Empirical Model Specification

To achieve the objectives of this study, the following estimable econometric models are specified.

3.4.1 The effect of socio-economic factors on fertility

To estimate the effect of socio-economic factors on utility, the study utilizes the Zero Inflated Poisson Model due to the nature of the data. Baundin (2015) explains that the Zero-Inflated Poisson Model (ZIP) is generally used to model count data while accounting for the presence of excess zeros and over dispersion. The model accounts for two specificities of fertility. First, it is a count variable that is discrete, positive with a limited range. Second, many childless women may be in the dataset, which would result in excess zero (Baundin, 2015).

The ZIP regression integrates the Poisson distribution and the logit distribution. The model firstly starts by estimating the standard Poisson regression model. The Poisson regression is used to estimate count data, for instance in this study the probability that fertility (C) takes a specific value is given by:

$\Pr[C = c_i / v_i] = \frac{e^{-ex} {w_i}^{ci}}{c_i!}$ .... (3.13)

Where Pr is the probability, $c_i = 0,1,2, \ldots$ is the number of children, v_i is the covariates of fertility and w_i is the mean parameter.

Since equation 3.13 does not account for women that have no children or account for excess zero observation in the fertility data, the Zero-Inflated model includes the logit distribution. The logit distribution model accounts for the count data that exhibit excess zeros. Basically, the Zero Inflated Model estimates the number of children born and the choice of not having children simultaneously using the passion model and logit model respectively (Lihawa, 2016). The logit model is expressed as:

$$\Pr[G^0 = \frac{1}{p_i}] = \Omega = \frac{e^{\varphi' p_i}}{1+e^{\varphi' p_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.14)}$$

Where G^0 denotes the number of women with no children which implies that fertility is 0. Making the probability that a woman has no children ($G^0 = 1$). The vector of independent variable that affects the choice for a woman to have no children is denoted by p_i and φ are the parameters to be estimated.

Given that the probability that a woman is in the zero group is $G^0 = 1$, the probability that a woman is not in the zero group is $G^0 = 0$ and it is equal to (1−Ω). Hence the probability for a zero count can be expressed as:

$$\Pr\left[c_i = {}^{0}/_{v_i}, p_i\right] = \Omega, (1 - \Omega) \Pr[c_i = {}^{0}/_{v_i}, G^0 = 1] \ldots\ldots\ldots\ldots\ldots\ldots \text{(3.15)}$$

While the probability for a woman to have a positive count can be expressed as:

$$\Pr\left[c_i = j > {}^{0}/_{v_i}, p_i\right] = (1 - \Omega) \Pr[c_i = j > {}^{0}/_{v_i}, G^0 = 0 \ldots\ldots\ldots\ldots\ldots\ldots \text{(3.16)}$$

These two equations (3.15 and 3.16) make up the Zero inflated model, where equation 3.15 is the estimation process that turns into a logit model and equation 3.16 is the modified Poisson model (Lihawa, 2016). Given the specific variables that the study intends to analyze the ZIP equation can be expressed as follows:

$$Fertility = \beta_0 + \beta_1 Age + \beta_2 Agesq + \beta_3 Employed + \beta_4 Education + \beta_5 Maritalstatus + \beta_6 Contra + \beta_7 Residence + \beta_8 Household + \beta_9 Wealth + \beta_{10} Radio + \varepsilon_i \ldots\ldots\ldots\ldots\ldots \quad (3.17)$$

The ZIP model is specified in equation (3.17) simultaneously estimates the number of children born using the Poisson model, and the choice of not having children using a logit model (Baundin, 2008). The standard Poisson and the ZIP models are not nested, and cannot be used to decide whether the distribution has excess zeros. Therefore, a Akaike Information Criteria(AIC) and Bayesian Information Criteria(BIC) test is performed to choose between the Standard Poisson and the ZIP model.

3.4.2 Effect of fertility on Maternal Health Status

The second objective of the study intends to analyze the effect of fertility on maternal health status which is proxied by Body Mass Index (BMI). The BMI is known as the value derived from the height and weight of a person. According to Lihawa (2016), the BMI identifies whether an individual is underweight, normal weight or overweight, specifically the study measures maternal health status using woman's BMI when the woman is underweight, because women who are underweight they are at a greater risk of premature births or pregnancy related deaths.

The current study uses a binary variable to determine whether a woman is underweight or not is expressed:

$$Y_i = \begin{pmatrix} 1 & if\ a\ mother\ is\ underweight \\ 0 & otherwise \end{pmatrix} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.18)$$

Given that the dependent variable is binary, the probit model was the most appropriate for estimation. However, due to the fertility variable being a discrete endogenous variable, the ivprobit model cannot be estimated to account for the endogeneity issue because it is not an appropriate model for discrete endogenous regressors (Lewbel *et al*., 2012). Namubiru (2014) explains that the issue of endogeneity can arise from three sources. The fertility variable is endogenous because it correlates with the error term, meaning that fertility can be affected by maternal health status. Firstly, the measurement errors, which happens when the model appears to have an imperfect measure of variables. Secondly, the reserve causality; occurs when the dependent variable impacts at least one of the explanatory variables. Thirdly, endogeneity may arise from omitted variable such that the researcher omits the unobserved variables. In this study the issue of endogeneity arises because of reverse causality of maternal health and fertility. Maternal health can affect fertility in such a way that lack of good maternal health is likely to decrease fertility rate. Therefore, a Linear Probability Model (LPM) is estimated to determine the effect of fertility on maternal health status. The model is specified as follows:

$$Prob\ (Y_i = 1/x_i) = Y = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k + \varepsilon_t \ldots\ldots (3.19)$$

The equivalent empirical model for equation (3.10) will be expressed as:

$$Y_i = \beta_0 + \beta_1 Fertility + \beta_2 Age + \beta_3 Agesq + \beta_4 Residence + \beta_5 Employmntstatus + \beta_6 Maritalstatus + \beta_7 Wealthindex + \beta_8 Education + \beta_9 Hhsize + \beta_{10} Contraceptives + \beta_{11} Radio + \varepsilon_t \ldots\ldots (3.20)$$

However, the fertility variable is endogenous and failure to account for this issue would lead to biased estimates. Given that the LPM cannot cater and treat endogeneity in variables, the Two-Stage Least Square model (2SLS) is applied. The 2SLS is an extension of the OLS method; it is used when the variable of interest (fertility) is correlated with the error term see (Wooldridge, 2010). The Two Stage Least Square makes use of instrumental variable that are uncorrelated with the error term to account for unexpected behaviors between variables. In this study, contraceptive is used is to instrument fertility. In order for a variable to be an instrumental variable it have to satisfy the following conditions: (i) it must have a casual effect on the endogenous variable; (ii) it must affect the outcome variable Y only through the endogenous variable; (iii) There is no confounding for the effect of Z on Y. These assumptions are satisfied since the use of contraceptives is assumed to reduce fertility levels and fertility does affect the use of contraceptives (it have a causal effect). Lihawa (2016) reports that, women who use contraceptives are more likely to have fewer children than their counterparts that does not. Contraceptive use will highly impact fertility by creating birth intervals and avoiding unwanted pregnancies. It is further argued that the use of contraceptives is unlikely to be correlated with other variables at the household level and considered the best instrument for fertility (Kaburo-Mariara *et al.*, 2009). Contraceptives use only affects maternal health through fertility (Namubiru, 2014), this indicates the assumption (ii). More so, contraceptive use is likely to be strongly correlated with fertility and not so much with maternal health. The 2SLS equation is specified as:

$$y_1 = y_2'\beta_1 + x'_1\beta_2 + \mu \text{ .... } (3.21)$$

Where y_1 is the dependent variable, y_2' is the endogenous variable, $x'_1$and are the exogenous variables.

$$y_2 = x_1'\gamma_1 + x_2\gamma_2 + \varepsilon$$

3.5 Definitions and Measurements of Variables

This section defines and explains the variables used in these empirical models above. Also, the expected relationships of the variables on the dependent variables are explained based on empirical literature.

Body Mass Index (BMI): The study uses Body Mass Index as the dependent variable in in the maternal health equations. In this study, BMI is defined as the weight of a woman (Kg) divided by the square height (m). The study assigns the value of 1 to women that are underweight and 0 to women that are not underweight. A woman is said to be underweight if she has a BMI<18.5kg/m^2, overweight when BMI>24.9 and of normal weight if 18.5<BMI>24.9. The appropriate measure of health status in adults is the BMI (Mwabu, 2009). Based on the assumption of the intertemporal nature of health, BMI therefore is the best measure of maternal health as it captures the changes in the health of the woman over a long period of time.

Fertility: The study measures fertility as the total number of children born to a woman (Baundin, 2015). This number includes children who are living or living elsewhere, born and later died of the sample women. It is the dependent variable in objective one that aims at estimating the socioeconomic determinants of fertility in Namibia. Fertility is expected to have a negative effect on maternal health status.

Age of the mother: The study measures age of the mother as the number of years from birth. The variable is included to represent the specific characteristics of the mother. It is expected to improve maternal health status as suggested by literature (Achieng, 2014; Lihawa, 2016).

Mother's age squared: The study included the age squared in order to reflect the nonlinear relationship between age and fertility. It is expected to have a positive effect on fertility (Namubiru, 2014).

Residence: The study measures the place of residence of a woman as a dummy variable were the value of 1 was assigned to a woman residing in an urban settlement and the value of 0 to a woman living in a rural area. Urban residence is expected to be associated with better health outcomes and lower probability of being underweight (Achieng, 2014). Consequently, those in urban areas are expected to have lower fertility rates compared to their rural counterparts (Blacklow & Church, 2006; Njoroge, 2015).

Woman's employment status: The study measures the employment status of a woman as a dummy variable were the value 1 is allocated to if a woman is employed and the value of 0 to otherwise. It is expected to have a negative effect on fertility (Adhikari, 2010). However, mothers participation in laborforce is expected to have a positive effect on her maternal health status (Lihawa, 2016).

Marital status: The study measures woman's marital statuses as a categorical variable where four categories were considered. Women who were never in union (reference category) was assigned the value of 0, married women and those living together with partners were assigned 1, 2 is assigned to widowed women and the value of 3 was assigned to women that are divorced and those no longer living together with ex partners. Married women are expected to have a higher fertility level than their unmarried counterparts (Njoroge, 2015)**.** Also, married women are expected to have a better health status (Girma & Genebo, 2002; Bitew & Telake, 2010).

Household Woman's wealth index: This variable captures the household standard of living based on asset ownership**.** This study measures wealth index as a categorical variable where three categories were considered. A woman in the poor quintile (reference category) was given the value of 0, a woman in the middle quintile was assigned the value of 1 and a woman in the rich quintile was assigned the value of 2. This variable is expected to have a negative effect on fertility (Bbaale, 2013; Namubiru, 2014). Consequently, the wealth index is expected to have a positive relationship with maternal health status (Lihawa, 2016).

Woman's education: This variable shows the level of education completed by a woman. The study assigns four categories to education. A woman with no education was used as the base category and assigned the value of zero, a woman with primary education is assigned the value of 1, a woman with secondary education is assigned the value of 2 and 3 was assigned to a woman with higher education. Empirical studies by Alemayehu *et al.*, (2010) and Indongo & Pazkawambia (2012) showed a negative relationship between education level and fertility. Additionally, studies by Meh *et al.,* (2019) and Achieng (2014) showed a positive relationship between education and women nutrition status.

The use of contraceptives: This is measured as the number of women who reported to use any contraceptive methods**.** A dummy variable of the value of 1 if a woman is making use of any contraceptives and 0 to otherwise. This variable is expected to have a negative effect on fertility (Palamuleni, 2017; Chemhaka and Odimegwu, 2019). Conversely, contraceptive use is can also have a positive relationship with fertility (Bhasin *et al.*, 2009).

Listening to radio: The variable measures how many women frequently listen to the radio. A dummy variable of the value of 1 if the woman listens to the radio and 0 to otherwise was given. Women who frequently listen to the radio is expected to have a lower fertility than women who do not (Lihawa, 2016).

3.6 Data type and Sources

The study utilizes cross-section secondary data sourced from the 2013 Namibia Demographic and Health Surveys to analyze the effect of fertility on maternal health status. The survey collects data on demographic, socioeconomic and health in Namibia. Specifically, it collects detailed information on fertility, family planning, child health and maternal health. The 2013 DHS is the fourth national representative of DHS surveys in Namibia following previous surveys in 1992, 2000, and 2006. The survey interviewed 10,473 women aged 15 to 49 years, 4,495 men aged 15 to 64 and 15,730 were under the age of 15. It is a national household-based survey that covered all 13 regions in the country with a total of 9, 849 household successfully interviewed.

The Survey was collected and stratified into two stages. In the first sampling stage 554 enumeration areas (EA) were selected, where 269 were in urban areas and 285 were in rural areas. Furthermore, the 13 regions were stratified in 26 strata (13 urban strata and 13 rural strata), where a complete household listing and mapping was carried out in all selected clusters. While, the second stage consists of; a fixed number of 20 households which was selected from every urban cluster and rural cluster as per the equal probability systematic sampling. To meet the study objectives, a sample of 10,018 women aged between 15-49 years were used. The 2013 Demographic and Health Survey is the only recent available data in addressing the research objectives as it the only secondary source that has all the required micro data for the study.

3.7 Data Analysis

The final data was obtained from individual record's file and generated through a merging process. The data were analyzed using STATA statistical package version 15.1. Firstly, descriptive statistics for the variables in the study were computed. Secondly regression analysis was used to analyze the data as per the study objectives. The first objective sought to analyze the effect of socioeconomic factors on fertility is achieved by estimating the Zero Inflated Poisson regression model. The Zero inflated models which model for excess zeros in dependent variables are used. According to Mouatassim and Ezzahid (2012), ZIP model assumes that results emerge from two processes. In the first process it models zero inflation by including the proportion of extra zero and in the second process it models the non-zero counts making use of zero truncated Poisson model. The second objective which is to determine the effect of fertility on maternal health, Linear Probability regression model was estimated using the Two Stage Least Square to account for the endogeneity of fertility.

3.8 Research ethics

The study adheres to all ethical behaviors of truthful reporting. The data shall not be distorted, falsified nor fabricated in any way. All sources used in the study shall be properly cited and acknowledged.

CHAPTER 4: EMPIRICAL FINDINGS

4.1 Introduction to Findings

The chapter presents the empirical results based on the methodology outlined in chapter 3. It conducts the discussion of descriptive statistics and the presentation of empirical findings.

4.2 Descriptive Statistics

To describe the basic feature of the data used in the study, descriptive statistics are used. Descriptive statistics include number of observations, mean, standard deviation, minimum and maximum. The summary statistics are presented in Table 4.1 and Table 4.2.

Table 4.1: Summary Statistics for the Discrete and Continuous Variables

Variables	Obs	Mean	Std. Dev.	Min	Max
Fertility	9,164	1.96	1.98	0	10
Body Mass Index	5,155	24.33	6.01	13.48	59.33
Age of mother	9,176	29.11	9.68	15	49
Age of mother square (years)	9,176	941.22	602.91	225	2401
Household size	9,844	5.68	2.98	1	15

Table 4.1 indicates that Namibian women have 2 children on average (1.96). This observation is relatively close to the average of two (1.85) children per woman indicated in the 2013 NDHS report. According to Lihawa (2016) total fertility is commonly higher than the average number of children per household/woman, because total fertility also represents the younger women who are yet to complete their reproductive cycle. In the case of this study total fertility was 3.6 children per woman (MoHSS and ICF International, 2014).

The 2013 Namibia Demographic and Health Survey (NDHS) surveyed women between the ages of 15 to 49 since this is the period when women are most fertile. Women have an average age of 30 years (29.11) with a variation of approximately 9 (9.68). The average body mass index (BMI) for women included in the survey was at 24 (24.33) weights per height in meters square with a minimum BMI of 14 (13.48) weight per height and a maximum of 59 (59.33) weight per height. The average household size was estimated at 6 (5.68) members per household, with a maximum of 15 members per household.

Table 4. 2 Summary Statistics for Categorical Variables

Variables	Measurement	Observations	Percentage
	1 if underweight	634	14.96
Mother's Underweight (bmi1)	0 otherwise	3,603	85.04
Place of Residence	1 if urban	5,163	51.54
	0 otherwise	4,855	48.46
Education	0 = no education	725	7.24
	1 = primary	2,300	22.96
	2 = secondary	6,241	62.3
	3 = higher	752	7.51
	1 if yes	4,145	41.61
Employment status	0 otherwise	5,816	58.39
Wealth quintiles	0 = poor	3,461	34.55
	1 = middle	2,048	20.44
	2 = rich	4,509	45.01
Contraceptives	1 if using	4,626	50.41

	contraceptives		
	0 otherwise	4,550	49.59
	1 if married	2,127	21.23
Marital status	0 otherwise	7,891	78.77
Radio	1 if yes	6,888	70.86
	0 if otherwise	2,833	29.14

Table 4.2 shows that 15 (14.96) percent of women in the survey have a BMI below 18.5 meaning that they are underweight. Moreover, about 52 (51.54) percent women reside in urban areas while 49 (48.46) percent reside in rural areas. The marital status was captured into two categories; women who were married and women not married. The unmarried category consists of women who have never been in a union, women living with partners, widowed and women who are divorced or separated. The statistics indicate that 21 (21.23) percent of the women in the survey are married whereas 79 percent are not married. In Namibia 41.61 percent of the surveyed women were reported to be employed and 58.39 were unemployed.

Furthermore, the statistics show that 7 percent of the women do not have any formal education, 23 percent have primary education, 62 percent have secondary education and 8 percent possess higher education. Contraceptives were captured into two categories: women using contraceptives and women not using contraceptives. In this instance, the study found that 50.41 percent of the surveyed women were using contraceptives and 49.59 percent were not using contraceptives. The wealth status was categorized into 3 quintiles such as poor (1st quintile), middle (2nd quintile) and rich (3rd quintile). The study found that 35 percent of the women were in the poor category, 20 percent were in the middle category and 45 percent of the women were in the rich category.

Lastly, 71 percent of the women had excess to news through listening to the radio, while 29 percent of the women surveyed had no excess to information or news.

4.3 Effects of Socio-Economic Factors on Fertility in Namibia

The first objective of the study is to determine the effect of socio-economics factors on fertility. Since fertility is a count variable, a Zero-Inflated Poisson model (ZIP) is estimated to analyze the effects of the socio-economic factors on fertility. In the study, fertility is defined as the number of children born per woman. The ZIP model was estimated to account for 2,723 (13 percent) women with no children in the survey. As previously mentioned in Chapter 3, this model generates two sets of results, firstly from the logit model which determines whether a woman belongs to the group of zero children and secondly the Poisson regression which shows the fertility count model of a woman with children (Lihawa, 2016).

The independent variables used in the ZIP model are the mother's age, place of residence, primary, secondary, higher education, mother's marital status, employment status, wealth index, listening to radio (excess to information), contraceptives prevalence, and household size. Table 4.3 presents the marginal effects of the ZIP model while the estimation results are presented in Appendix A.1.

Table 4. 3 Socio-economic determinants of fertility using Zero-Inflated Poisson Model

Variables	Marginal Effects	Std. Error	P-value
Mothers age	0.364***	0.011	0.000
Mothers age square	-0.004***	0.000	0.000
Place of residence (urban)	-0.093***	0.029	0.002
Primary Education	-0.064	0.056	0.252

Secondary Education	-0.622***	0.054	0.000
Higher Education	-0.994	0.068	0.000
Employed	-0.047*	0.026	0.07
Marital status	0.312***	0.030	0.000
Contraceptives	0.164***	0.024	0.000
Wealth index: Middle	-0.179***	0.036	0.976
Wealth index: Rich	-0.364***	0.038	0.955
Household size	0.059***	0.004	0.000
Radio	-0.092***	0.026	0.001
Zero observations	2,540		
Non-zero observation	6,133		
No. of observation	8,673		
LR Wald chi2 (13)	4,621.45		

Note ***, **, * denote Significance at 1% 5% and 10% respectively

The coefficient of mother's age was found to be positive and statistically significant at one percent level. This indicated that holding other factors constant, the older a woman gets the higher the number of children she will have. Based on the results, an increase in the in-woman's age by one year would increase fertility by a margin of 0.36, holding other factors constant. The coefficient of mother's age square was, however, negative but also statistically significant at one percent level, hence, making the relationship between mother's age square and fertility non-linear. Furthermore, the mother's age square results indicates that a woman's reproduction system is viable as age increases, however at some turning point in age fertility of the woman starts to decline. These results are consistent with the findings of Ewemooje *et al.*, (2020), Ayele

(2015) and Namubiru (2014) whose studies found a positive relationship between mothers' age and fertility in South Africa, Ethiopia, and Uganda respectively.

The coefficient of urban was found to be negative and statistically significant at one percent level. These results indicate that a negative relationship between mothers residing in urban areas and fertility. The findings show that holding other factors constant; women residing in urban areas have lower fertility with a margin of 0.09 compared to women residing in rural areas. According to Adhikari (2010) women in urban areas are likely to prefer fewer children because they dedicate most of their time to education and careers and have less time to care for an additional child. The findings in this study are similar to those of Ushie *et al.*, (2011) and Ayele (2015) who concluded that woman in urban areas have fewer children than woman living in rural areas in Nigeria and Ethiopia respectively.

The coefficient of mothers' employment status was found to be negative and statistically significant at ten percent level. The estimated results found that holding other factors constant, mothers' who are employed are more likely to have fewer children by a margin of 0.04 compared to mothers who are unemployed. Employed mothers are more likely to be well informed and are financial independent to make their own choice when it comes to the number of children they would like to have. These findings complement those of Becker (1960) and Lihawa (2016) who found that an employed mother is likely to have fewer children than an unemployed mother.

The study found that education was an important determinant of fertility with no education was used as a base category. The coefficients of secondary and higher education were all found to be negative and statistically significant at one percent level. These results show that woman with secondary and higher education are likely to have fewer children than woman with no education holding other factors constant. Furthermore, the estimated results found that women with primary, secondary and higher education are likely to have fewer children by margins of 0.62 and 0.99 respectively compared to women with no education holding other factors constant. From the findings, it can be observed that the more a woman is educated the more likely she will have fewer children, meaning they are more informed and aware of modern family planning methods. These findings support those obtained by Ushie *et al.,* (2011) who found that the better educated the woman the fewer children she will have in Nigeria.

The coefficient of marital status of the mother was found to be positive and statistically significant at one percent level. This implies that when a woman is married, she is more likely to have more children compared to a woman that is not married, holding everything else constant. The estimated results show that, holding everything constant the fertility of married woman increases by a margin of 0.31 compared to a woman that is not married. This could be a result of improved socio-economic status among women that are married. This finding is consistent with the study by Lihawa (2016) who found a positive relationship between fertility and married woman in Tanzania.

Furthermore, the study found household size to be an important determinant of fertility. The coefficient of household size is positive and statistically significant at one percent level. This implies that woman who live in large households are more likely to have more children holding other factors constant. Based on the estimated results, fertility of woman living in a large household increases by a margin of 0.06 holding all factors constant. These findings are similar with those of Ewemooje *et al.,* (2020) who found a positive relationship between household size and fertility in South Africa.

The coefficient of using contraceptive was found to be positive and statistically significant at one percent level. The estimated results indicate that women who choose to use contraceptives are more likely to have more children by a margin of 0.164, compared to women who choose not to use contraceptives, holding other factors constant. In contrast to the expectations, the study indicates that women who make use of contraceptives have more children. This could imply that women adapt contraceptives when they have reached the target number of children they would like to have. Another contributing factor to the positive relationship between contraceptive use and fertility could be that; whilst there is a provision for contraceptives in Namibia, there is still a limited accessibility of contraceptives for women in rural areas (Indongo, 2007). These findings are consistent with those of Bhasin *et al.,* (2010) who found a positive relationship between contraceptive and fertility in Ghana.

Furthermore, the coefficient of information (listening to the radio) was found to be negative and statistically significant at one percent level. This indicates that women who listen to the radio are more likely to have fewer children by a margin of 0.09 compared to women that do not listen to the radio, holding other factors constant. This is consistent with the notion that the spread of information on family planning on the radio will lead to awareness, thus leading to a reduction in fertility. The results are similar with those of Lihawa (2016) who found a negative relationship between listening to the radio and fertility in Tanzania.

4.4 The effect of fertility on Maternal Health Status in Namibia.

The second objective examines the effect of fertility on maternal health status in Namibia. This objective is addressed by making use of the instrumental variable Two-Stage Least Square (2SLS) approach. Additionally, to provide more information and a more comprehensive understanding on the topic the study estimated the Ordinary Least Squares (OLS), Linear Probability model (LPM) and the probit model and the results are presented in the appendix.

In the first part of this section, the study analyzes the effect of fertility on maternal health status using body mass index as the dependent variable and the second part uses underweight as the dependent variable. Body mass index (BMI) is achieved by dividing the mother's weight (kg) over mother's height (meters square). Therefore, the study considered BMI it as a continuous variable and the first part consisted of a mixture of both continuous categorical explanatory variables. The study included fertility, mother's age, mothers age square, place of residence, education, wealth index, mothers' employment status, marital status, household size and radio as explanatory variables. In the second part the dependent variable (underweight) is a binary variable; 1 if mother is underweight and 0 otherwise. In both sections fertility is instrumented using the use of contraceptives to account for the endogeneity issues between fertility and maternal health status.

Table 4.4: Effect of Fertility on Maternal Health: Body Mass Index

IV/ESTIMATES USING 2SLS			
Variables	**Coefficients**	**Robust Std Error**	**P-value**
Fertility	2.614***	0.894	0.003
Mother's age	-0.318	0.282	0.260
Mother's age square	0.003	0.003	0.361
Place of Residence: Urban	0.494**	0.233	0.034
Employed: Yes	0.990***	0.239	0.000
Marital Status: Married	0.469	0.538	0.383

Household size	-0.278***	0.079	0.000
Listen to radio	0.714***	0.251	0.004
Primary education	-0.037	0.461	0.936
Secondary education	2.571***	0.945	0.007
Higher education	4.100***	1.391	0.003
Middle wealth index	1.925***	0.363	0.000
Rich wealth index	3.815***	1.223	0.000
Constant	21.934***	3.43	
Observations	4,141		
Wald Chi2 (13)	983.97		
F(13,4127)	449.43		
Durbin (score) Chi2(1)	10.4244		0.0012
Wu-Hausman F(1,4126))	10.4128		0.0013

Note ***, **, * denote Significance at 1% 5% and 10% respectively.

4.4.1 Results from IV/Two Stage Least Square Approach: BMI

The coefficient of fertility was found to be positive and statistically significant at one percent level. The estimated result shows that an additional child to a woman increases the woman's BMI by 2.61. It is well known that woman pick up weight during pregnancy and after pregnancy leading to an increase in the BMI. This is consistent with the study by Bakhishi et al (2008) who found that Body Mass Index of a woman increases with the number of children the woman have in Iran.

Fertility was considered to be an endogenous variable and contraceptive was identified as an instrument. To see if contraceptive use was an appropriate instrument, it was tested for strength and relevance. The study found that the first stage F-statistics was 1107.46 with a p-value = 0.000, this suggests that contraceptives use is a strong and relevant instrument for fertility. Furthermore, Durbin-Wu-Hausman test was conducted to test whether fertility was endogenous in the Body Mass Index model. The Durbin- Wu-Hausman test was found to be statistically significant with Durbin (score) Chi2 (1) = 10.4244 with a p-value = 0.0012 and Wu-Hausman F (1,4126) = 10.4128 with a p-value = 0.0013. The study therefore rejects the null hypothesis of exogenous fertility.

The coefficient of urban was found to be positive and statistically significant at five percent level. The study found that a woman who resides in an urban area had a BMI of 0.494 points higher compared to a woman living in a rural settlement. This can be explained by the fact that women who stay in urban areas have excess to better nutrition and health facilities than women in rural areas. Additionally, women in urban areas do not need to travel long distance for basic needs and food. These findings are similar with those of Jose and Navaneethan (2016), who found a positive relationship between women who reside in urban areas and BMI in India.

The study found mother's employment status to be positive and statistically significant at one percent level. The estimated results found that an employed woman had a BMI of 0.99 points higher than a woman that is unemployed, holding other factors constant. These results indicated that an employed woman is able to enhance her well-being through improving her diet. In addition, an employed woman is more likely to be more empowered and can make her own decision unlike an unemployed woman. These findings are consistent with those of who Achieng (2014) found a positive relationship between mothers' employment status and BMI in Kenya.

The coefficient of household size was found to be negative and statistically significant at one percent level. The estimated results indicates that one additional member in the household reduces the BMI of mothers by 0.28 holding other factors constant. This shows that an increase in the household size will lead to the mother to face resource deprivation and more household chores leading to a reduction in body mass index. The negative relationship found in this study may be an indication that woman in large households with younger children tends to have a low BMI as they may spend much of their energy on taking care of these children. These findings are consistent with those of Dihiya and Viswanathan (2014) who found a negative relationship between large households with younger children and body mass index in India.

Making use of no education as the reference category, the coefficients of secondary and higher education were found to be positive and statistically significant at one percent level. The estimated results indicate that secondary and higher education increased the woman BMI by 2.57 and 4.10 respectively compared to a woman with no education, holding other factors constant. Considering the magnitude of the results, women with secondary education and higher education have more power and knowledge to make their own decisions regarding maternal health, dietary choices and their well-being in general unlike their counterparts with no education. These findings are similar to those of Lihawa (2016) who found a positive relationship between education and BMI in Tanzania.

Making use of the poor wealth quintile group as the reference category, the study found that the coefficient of middle and rich wealth quintile groups to be positive and statistically significant at one percent level. The study estimated results shows that women in the middle and rich wealth quintiles increased their BMI by 1.93 and 3.82 respectively compared to woman in the poor wealth quintile, holding other factors constant. This indicates that as women move from the poorest quintile to the highest quintile, their BMI tend to increase meaning that these women are economically more capable to afford better nutrition, better services for instance health services. These findings are consistent with those of Girma and Genebo (2002) who found that women in poor wealth quintile are at a risk of being undernourished in Ethiopia.

Listening to the radio was found to be an important determinant of maternal health in Namibia. The study found the coefficient of listening to the radio to be positive and statistically significant at one percent level. These estimated results show that holding other factors constant; women who listen to the radio/news increased their BMI by 0.71 compared to women that do not listen to the radio. The finding emphasizes the importance of listening to news (on the radio) as it exposes mothers to information which are beneficial to their nutrition intake and health. The results are similar with the studies by Mwangakala (2016) who associated a positive relationship between access to news and maternal health in rural Tanzania.

Table 4.5: The Effect of Fertility on Maternal Health (Underweight)

IV/ESTIMATES USING 2SLS			
Variables	**Coefficients**	**Robust Standard Error**	**P-value**
Fertility	-0.166**	0.082	0.043
Mother's age	0.021	0.026	0.437
Mother's age square	0.000	0.000	0.929
Place of Residence: Urban	-0.009	0.017	0.610
Employed: Yes	-0.068***	0.02	0.001
Marital Status: Married	0.034	0.053	0.521
Household size	0.017***	0.006	0.008

Listen to radio	-0.025	0.021	0.227
Primary education	0.047	0.032	0.137
Secondary education	-0.120*	0.076	0.085
Higher education	-0.217*	0.113	0.055
Middle wealth index	-0.070**	0.031	0.023
Rich wealth index	-0.110**	0.039	0.005
Constant	-0.006	0.325	0.986
Observations	3,487		
Wald Chi2	148.98		
Durbin (score) Chi2 (1)	5.08614		0.0241
Wu-Hausman F(1,3472)	5.08614		0.0244

Note***, **, * denotes significance at 1%, 5% and 10% respectively.

4.4.2 Results from IV/Two Stage Least Square Approach: Underweight

The coefficient of fertility was negative and statistically significant at five percent level, with a marginal effect of 0.17. The estimated result indicates that an additional child born to a woman decreases the probability of being underweight by 0.17, holding other factors constant. The finding implies that the more children a woman has the more likely she will gain weight from the pregnancies. These findings are consistent with those of Bakhishi (2008) who found that woman tend to gain weight with the more children they have in Iran. Furthermore, to test whether fertility was endogenous in the maternal health model the Durbin-Wu-Hausman test was conducted. The results come out statistically significant at five percent level, with Durbin (score) chi2 (1) = 5.08614 (P = 0.0241) and Wu-Hausman F (1, 3472) = 5.08614 (P = 0.0244). This verifies that fertility is endogenous.

The study found that mother's employment status coefficient was negative and statistically significant at one percent level, with a marginal effect of 0.07. The estimated results imply that a woman who is employed compared to a woman who is unemployed reduces the probability of being underweight by 0.07, other factors held constant. The findings suggest that mothers that are employed have a better chance at providing for themselves with good nutritional diets and improve their well-being unlike their counterparts that are unemployed. These results are similar with those of the study by Amugsi (2020) who found that mothers who are employed have better maternal health status than mothers who are unemployed in three Sub-Saharan African countries.

The household size coefficient is found to be positive and statistically significant at five percent level with a marginal effect of 0.02. The estimated results show that an additional member to the household is likely to increase the probability of the mother being underweight by 0.02, other factors held constant. Mothers in larger household face challenges such as resource deprivation and lack of sufficient nutrition which can lead to the probability of mother's being underweight. These findings are similar to those of Dihiya and Viswanathan (2015) and Amugsi (2020) who found that the more the household size increases the more likely the mothers' maternal health to decline in India and three Sub-Saharan countries respectively.

Furthermore, the coefficients of secondary and higher education were found to be negative and statistically significant at ten percent level. This suggests that a mother with secondary and higher education reduces the probability of a mother being underweight by 0.12 and 0.22 respectively compared to a mother with no education, holding other factors constant. This shows that an education mother is more likely to be economically capable on spending on food and health care compared to an uneducated mother. An educated woman has more access to information on the best healthy diets to meet her nutritional requirements. The findings are similar with those of Jose and Navaneethaman (2014), Mwangakala (2016) who found that a mother with an education is better equipped with knowledge and skills to manage her health in India and Tanzania respectively.

The coefficient of middle and rich wealth quintile was found to be negative and statistically significant at five percent level and one percent level respectively, with marginal effects of 0.07 and 0.11 respectively. The poor wealth quintile was used as the base category. The findings show that a mother that is in the middle and rich wealth quintile will reduce the probability of being underweight by 0.16 and 0.21 respectively, compared to a mother in the poor wealth quintile, holding other factors constant. Based on the magnitude of the results, it is evident that woman in higher socioeconomic status enjoy better due to accessibility of resources unlike their counterparts in the poor category. Lihawa (2016) Adeoti and Awoniyi supports these holdings by concluding that a mother with better socioeconomic status would be negatively associated with underweight in Tanzania and Kenya respectively.

Finally, based on the estimated results on maternal health status, the study found age of the mother, marital status and primary education to be statistically insignificant at all levels in the Body Mass Index model, while mothers' age, mothers age square, primary education, marital status and radio to be statistically significant at all levels in the underweight model.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter presents the summary of the results as well as the conclusion of the study. Furthermore, the chapter also suggests policy implications based on the results. As a way of filling the gaps, suggestions for further studies are made.

5.2 Summary of the results

The study examined the effect of fertility on maternal health in Namibia making use of the 2013 Demographic and Health survey data. In the first objective, the study analyzed the effect of various socio-economic factors on fertility in Namibia. The number of children ever born to a woman was used as a measure of fertility which was the dependent variable. The study estimated a Zero-inflated Poisson (ZIP) to account for count data and excess zeros. The study results found that age of the mother, mother's marital status (married), household size and the proportion of contraceptive use had positive and statistically significant effect on fertility. Conversely, urban residence, education (primary, secondary and higher) and listening to the radio (excess to information) had negative and statistically significant effect on fertility.

The second objective sought to examine the effect of fertility on maternal health status in Namibia. The study made use of body mass index (BMI) and mother being underweight as dependent variables. The study employed the Linear Probability Model (LPM) and Two Stage Least Square models (2SLS) to estimate the effect of fertility on maternal health status outcome. Additionally, the study used contraceptive use as an instrument for fertility in the maternal health status model to account for the possibility of endogeneity issues.

The estimated results from the 2SLS found fertility, urban residence and employment status of the mother to have positive and significant effect on body mass index (maternal health). Similarly, secondary and higher education, household wealth quintiles (middle and rich) and listening to the radio (excess to information) significantly increased the body mass index of the mother. On the other hand, mother's age and household size were found to significantly reduce the mother's body mass index. Moreover, the coefficient of fertility residual and its interaction was found to be significant indicating endogeneity.

In the underweight model, fertility, employment status of the mother, secondary and higher education and wealth quintile (middle and rich) significantly reduced the probability of a mother being underweight. While, household size, listening to the radio and primary education were found to significantly increase the probability of a mother being underweight.

5.3 Conclusions of the study

The purpose of the first objective was to examine the effect of socioeconomic factors on fertility in Namibia. Based on the results obtained from the study using the 2013 Namibia Demographic and Health Survey (NDHS) data, the study confirms that most socioeconomic factors significantly affect fertility in Namibia. Among the identified women (15-49 years), the older the woman get the more likely she will have more children. Similarly, the study found married women to have more children than their counterparts. Furthermore, the study found that women with either an education or living in urban area or frequently listening to the radio tend to have fewer children, meaning these women are more informed when it comes to family planning. However, the study observed that contraceptives use tend to increase with fertility, which can be a consequence of contraceptives not being used correctly or successfully.

Further, the study also observed how fertility influences the maternal health status in Namibia. Making use of an instrumental variable estimation (2SLS) the study presented evidence that an increase in the number of children increases the mother's body mass index but decreases the probability of the mother being underweight. This relationship can be explained by the fact that mothers tend to gain more weight after giving birth and are less likely to be underweight. The study also confirms that a mother living in an urban area or being employed or frequently listens to the radio is likely to increase body mass index and are less likely to be underweight. Similarly, a mother with a secondary/tertiary or from a middle and rich wealth household is also likely to increase the body mass index and decrease the probability of being underweight. However, mother's age and household size were found to significantly decrease body mass index where household size increase the probability of a mother being underweight.

5.4 Policy recommendations

Based on the results obtained from the empirical study, the study draws the following policy recommendation that can be used to address fertility and maternal health in Namibia:

(i) Promoting women empowerment

Promoting women empowerment is one of the many ways to improve maternal health and reduce fertility levels. Firstly the Namibian government needs to invest in female education. Based on the findings of this study, women with education were found to have lower fertility levels in Namibia compared to women with no education. The study further found secondary and higher education to positively influence maternal health, while primary education had an insignificant effect on maternal health. The Namibian government enforced free primary and secondary education in 2013 and 2016 respectively. However, due to the statutory obligation of parents to contribute to the school development fund, education in Namibia is not entirely considered as free. There are certain activities crucial for the development of learners, for instance sports culture and recreational activities that the government does not cover hence the school development fund. Therefore, the Namibian government needs to request assistance and engagement from stakeholders and local innovators to invest in education to be able to cover for all school activities, so that no child is left out.

Secondly, the Namibian government needs to promote female employment. An employed woman can earn income that can essentially empower them to afford a healthy diet and be able to make wise decisions concerning their reproductive health. More so, women being financially independent can reduce fertility and improve their maternal health. This has been shown by the findings of the study on the positive relationship between mother's employment status and body mass index. When mothers are economically dependent the aspects of dependents on their husbands and partners may weaken giving them more power and voice on making decisions especially concerning the number of children they would like to have. Ultimately this will lead to lower fertility levels and improve maternal health status in Namibia. Hence, it is imperative that the government implements policies focused on increasing women participation in the labor market or aid in promoting women entrepreneurs by availing subsidies for women in business.

(ii) Maternal education and promotion of family planning programs

It is of importance that the Namibian government through the Ministry of Health and Social Services (MoHSS) invest in programs aimed at educating women on maternal health and the importance of family planning (reducing fertility). Family planning awareness programs especially the use of contraceptives is crucial for the country since the empirical study found a positive effect between fertility and contraceptive use inferring that contraceptives are not being used correctly. The MoHSS can organize workshops for women to educate them on the effect of increased fertility. These programs can also be extended and spread out to accommodate men for the illustration of how to use contraceptives effectively and correctly. Furthermore, the government of Namibia needs to increase health infrastructure particularly in rural areas for expecting mothers to have easier excess to health facility. By building more hospitals and clinics the government will have half-way met the goal of improving mother maternal health status in Namibia.

5.5 Areas for further research

This study looked at the effect of fertility on maternal health status in Namibia as well as the socio-economic determinant of fertility. Further research can be carried out to improve the findings obtained. Studies can make use of a different proxy for maternal health such as maternal mortality ratio and adding overweight and blood pressure to the explanatory variables. Moreover, there is also a need to conduct studies using recent Demographic and Health Survey data which is estimated to be released in 2021. Lastly further studies can be estimated on the effect of fertility on the health of children.

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APPENDICES

Appendix 1: Actual Coefficient from the Zero-Inflated Poisson Model (ZIP)

Table A1: Estimation of ZIP Model: Socio-Economic Determinants of Fertility

Variables	**Coefficients**	**Standard Error**	**P-Value**
Mothers age	0.238***	0.009	0.000
Mothers age square	-0.003***	0.000	0.000
Place of residence (urban)	-0.061***	0.019	0.002
Primary Education	-0.032	0.027	0.248
Secondary Education	-0.362***	0.027	0.000
Higher Education	-0.664***	0.046	0.000
Employed	-0.031*	0.017	0.071
Marital status	0.192***	0.017	0.000
Contraceptives	0.107***	0.016	0.000
Wealth index: Middle	-0.109***	0.022	0.000
Wealth index: Rich	-0.235***	0.024	0.000
Household size	0.039***	0.003	0.000
Radio	-0.059***	0.018	0.001
Constant	-3.761***	0.156	0.000
Inflate (Probability of zero birth)			
Mothers age	-1.033***	0.089	0.000
Place of residence (urban)	-0.195	0.297	0.511
Primary Education	0.068	0.747	0.927
Secondary Education	0.883	0.739	0.233
Higher Education	3.819***	0.936	0.000

Employed	-0.764	0.465	0.100
Marital status	-15.004	699	0.983
Contraceptives	-2.086***	0.327	0.000
Wealth index: Middle	0.117	0.351	0.740
Wealth index: Rich	1.162***	0.346	0.001
Household size	-0.04	0.041	0.330
Zero observations	2,540		
Non zero observation	6,133		
No. of observations	8,673		
LR chi2(13)	4621.45		

Note ***,**,* denote significance at 1% 5% 10% respectively

Appendix 2: Estimation results of LPM, Probit, 2SLS (Actual) and IV probit

Table A.2: Estimation of LPM: Effect of fertility on maternal health (Body Mass Index)

Variables	**Coefficients**	**Robust Std Error**	**P-Value**
Fertility	0.157**	0.069	0.023
Mothers age	0.397***	0.066	0.000
Mothers age square	-0.004***	0.001	0.000
Place of residence (urban)	0.311	0.191	0.103
Primary Education	-0.601	0.381	0.115
Secondary Education	0.144	0.375	0.701
Higher Education	0.488	0.512	0.34
Employed	0.634***	0.381	0.001
Marital status	1.777***	0.375	0.000
Contraceptives	0.520***	0.164	0.002
Wealth index: Middle	1.241***	0.215	0.000
Wealth index: Rich	2.711***	0.228	0.000
Household size	-0.074***	0.164	0.005
Radio	0.344**	0.215	0.038
Constant	13.384***	0.992	0.000
No. of observations	4,141		
F(14, 4126)	104.15		
R-squared	0.249		

Note ***, **, * denote significance at 1% 5% 10% respectively

Table A.3: Estimation of LPM: Effect of fertility on maternal health (Underweight)

Variables	Coefficients	Robust Std Error	P-Value
Fertility	-0.005	0.005	0.281
Mothers age	-0.028***	0.005	0.000
Mothers age square	0.000***	0.000	0.000
Place of residence (urban)	-0.001	0.015	0.925
Primary Education	0.059**	0.028	0.036
Secondary Education	0.01	0.027	0.696
Higher Education	-0.005	0.034	0.888
Employed	-0.043***	0.013	0.001
Marital status	-0.063***	0.015	0.000
Contraceptives	-0.028**	0.012	0.02
Wealth index: Middle	-0.023	0.017	0.184
Wealth index: Rich	-0.044**	0.018	0.014
Household size	0.005**	0.002	0.024
Radio	0.002*	0.014	0.087
Constant	0.59	0.081	0.000
No. of observations	3,487		
F(14, 3472)	13.18		
R-squared	0.0539		

Note ***, **, * denote significance at 1% 5% 10% respectively

Table A.4: Estimation of Probit: Effect of fertility on maternal health (Underweight)

Variables	Coefficients	Robust Std Error	P-Value
Fertility	-0.016	0.022	0.47
Mothers age	-0.111***	0.021	0.000
Mothers age square	0.002***	0.000	0.000
Place of residence (urban)	0.000	0.067	0.995
Primary Education	0.221*	0.123	0.073
Secondary Education	0.037	0.122	0.759
Higher Education	-0.080	0.184	0.665
Employed	-0.229***	0.065	0.000
Marital status	-0.383***	0.098	0.000
Contraceptives	-0.115**	0.055	0.039
Wealth index: Middle	-0.091	0.074	0.219
Wealth index: Rich	-0.201**	0.079	0.011
Household size	0.022**	0.009	0.017
Radio	0.014	0.059	0.811
Constant	0.655**	0.323	0.042
No. of observations	3,487		
Wald chi2(14)	167.09		
Pseudo R2	0.0633		
Log Likelihood	-1403.1017		

Note ***, **, * denote significance at 1% 5% 10% respectively

Table A.5: Estimation of IVProbit: Effect of fertility on maternal health (Underweight)

Variables	Coefficients	Standard Error	P-Value
Fertility	-0.521**	0.166	0.002
Mothers age	0.068	0.076	0.374
Mothers age square	0.000	0.001	0.907
Place of residence (urban)	-0.234	0.058	0.683
Primary Education	0.135	0.115	0.240
Secondary Education	-0.414**	0.179	0.021
Higher Education	-0.730**	0.251	0.004
Employed	-0.256***	0.059	0.000
Marital status	0.009	0.187	0.941
Wealth index: Middle	-0.219**	0.073	0.003
Wealth index: Rich	-0.364***	0.078	0.000
Household size	0.055***	0.012	0.000
Radio	-0.076*	0.061	0.217
Constant	-1.371*	0.824	0.096
No. of observations	3,487		
Wald Chi2 (13)	375.41		
Log Likelihood	-7111.4269		
Wald test of exogeneity (Prob > chi2)	4.52		0.0335

Note ***, **, * denote significance at 1% 5% 10% respectively