LUND UNIVERSITY
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Impact of Women Education on Fertility: A case study of The Gambia

To what extent do women's education affect fertility? Evidence from The Gambia Demographic and Health Survey Data

by

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Abstract

This research contributes to the ongoing debate on whether women's education and fertility are inversely related. It is seen that during the premodern era, the number of children born per woman was high and the only thing that kept population growth low was the high death rate. However, the modernization of societies resulted in a reduction in the number of births per woman. Hence the causes of this reduction in the number of births rate are subject to debate. Thus, this paper seeks to inquire whether empowering women through education could be a cause for this reduction in the number of children per woman(fertility) in The Gambia. The 2013 wave of Demographic and Health Survey Data of the Gambia was employed in a cross-sectional study using negative binomial regressions. The result for educational attainment, suggests that women with primary, secondary, and higher levels of education will have a lower number of children compared to women with no education. This estimate for educational level agrees with many works of literature on fertility. Thus, the paper concludes that education is negatively related to fertility.

Keywords: fertility, women education, negative binomial distribution, Poisson

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LIST OF ABBREVIATIONS

GDHS	Gambia Demographic Health Survey
FGM	Female Genital Mutilation
GBOS	Gambia Bureau of Statistics
FP	Family Planning
GoG	Government of The Gambia
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
WDI	World Development Indicators
MICS	Multiple Indicator Cluster Surveys
UN	United Nations
TFR	Total Fertility Rate
IRR	Incident Rate Ratio
NHRC	National Human Rights Commission
SRH	Sexual and Reproductive Health
UNESCO	United Nations Educational, Scientific and Cultural Organization
CEDAW	Convention on the Elimination of all Forms of Discrimination against Women
IFHHRO	International Federation of Health and Human Rights Organizations
ASRM	American Society for Reproductive Medicine
CETERIS PARIBUS	Holding other things constant

CHAPTER 1: INTRODUCTION

1.1.Background

At the time of modernization of societies, demographers have found that almost all parts of the world have experienced a demographic transition in their human population (Goujon et. al. 2015). During this period, researchers have seen a decline in mortality rates due to socioeconomic development and the presence of an improved public health system (Goujon et. al. 2015). As the number of death declines and health improves, we realized a rising population growth (Roser, 2014). However, this rapid population growth slows down as the global fertility rate, as one of the components of population growth, decreases and approaches almost less than 2.5 children per woman compared to the pre-modern era where women were having high fertility rates of 4.5 to 7 children per woman (Roser, 2014).

However, putting the above in the Sub-Saharan African context, researchers have seen Sub-Saharan Africa as the last region of the world that has experienced this demographic transition due to the late realization of a fall and an unsustainable decline in the birth rates of women. Several authors raised the alarm on the "Stalls in Africa's fertility decline"(Goujon et. al. 2015). These authors conducted a study on how education stalls might affect the fertility transition. Their analysis shows that the stall in education for women born between 1975 and 1985 in some African countries has led to the stalls in fertility decline experienced from 1995 to 2010 (Goujon et. al. 2015). Again, they have also realized that other parts of Sub-Saharan Africa that did not experience these education stalls have observed an ongoing fertility decline in contrast to those experiencing the education stalls. They have concluded that education discontinuity in countries affected has affected their fertility transition (Goujon et. al. 2015). According to the World Development Indicator (2019), the aggregate number of births per woman in Sub Saharan Africa excluding high-income countries has declined from 6.7 in the 1980s to 5.8 in 2000 and stood at 4.7 as of 2017 (World Development Indicator 2019).

Looking at this fertility transition, one might still argue that Sub-Saharan Africa has experienced a very slight decline in their total number of births per woman compared to other regions of the world such as South Asia, Latin America and the Caribbean whose fertility rate (number of children per woman) stood at 2.4 and 2.0 respectively as of 2017 (World Development Indicator 2019). According to Bongaarts and Casterline (2013), this high number of births per woman linked with declining mortality is what resulted in rapid population growth in Sub-Saharan Africa (Bongaarts & Casterline, 2013). Looking at the United Nation's population estimates, Sub-Saharan African countries have

undergone an increase in population growth in the second century of the new millennium from 6.8 million in 2001 to 8.9 million in 2011 and 1.1 billion in 2018 (World Development Indicator 2019). Based on the foregoing, the United Nations projects a rise in the Sub-Saharan Africa population in 2050 and 2100 from 1.9 billion to 3.36 billion respectively (Bongaarts & Casterline, 2013). With such forecasting on a gross increase in human figures, Bongaarts and Casterline (2013) believed this will lead to various social, economic, and environmental challenges that might cripple the continent's capacity in raising the living standard of its people.

Figure 1: The total fertility rate by world regions

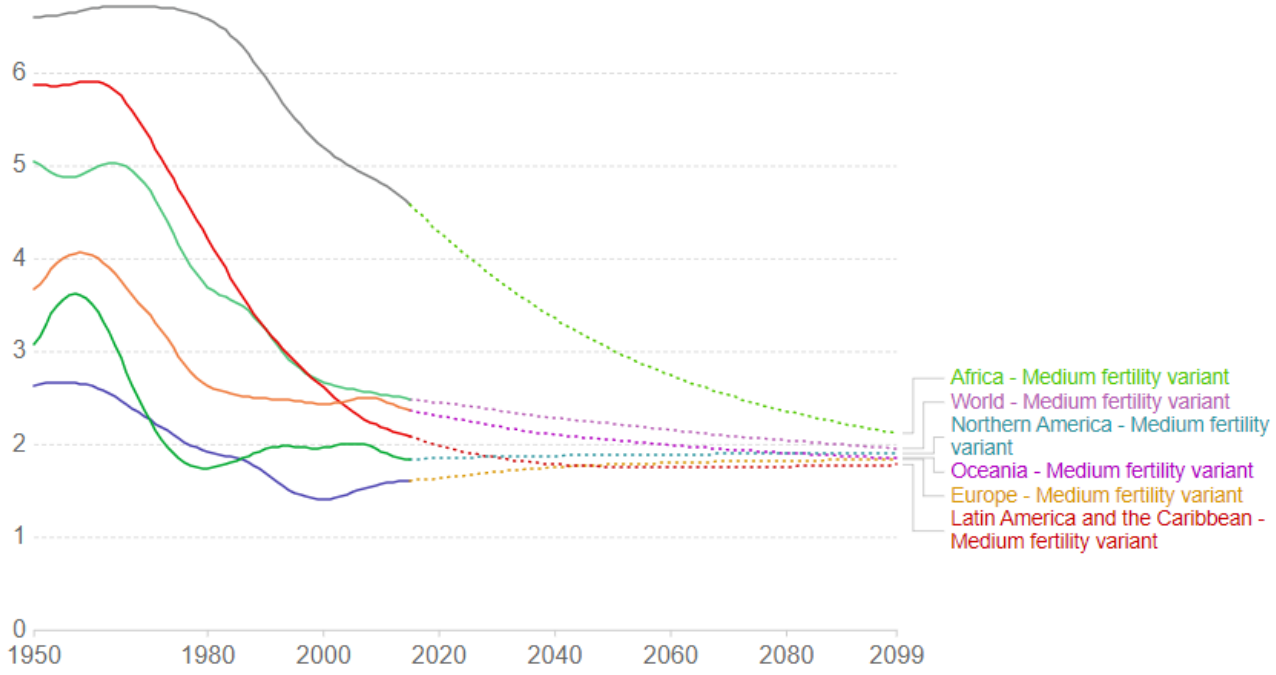


Figure 1 indicates the total fertility rate by world region including the UN projections through 2100 (1950 to 2099) **(**Total Fertility Rate is defined as the average number of children that would be born to a woman over her lifetime if the woman were to experience the exact current age-specific fertility rates, and the woman were to survive from birth to the end of her reproductive life.)

Source: UN Population Division (2017) https://ourworldindata.org/fertility-rate

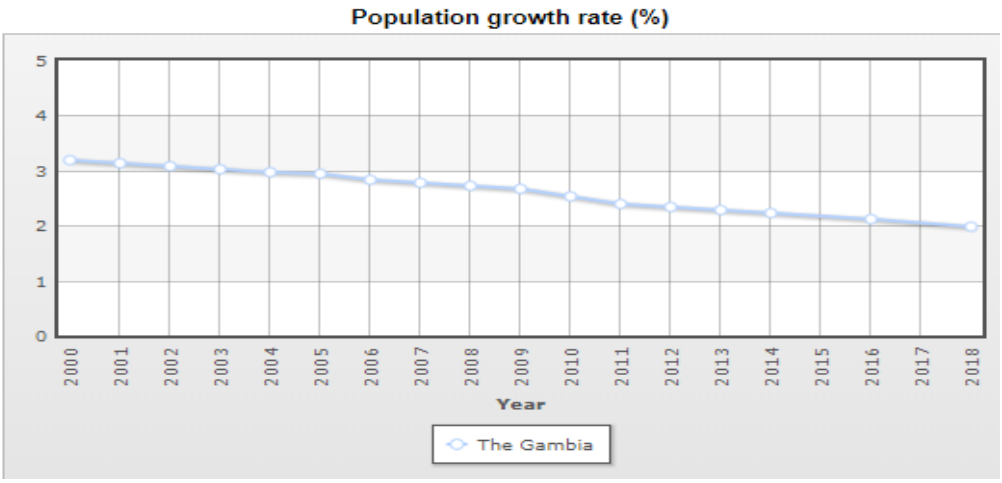
Looking at the Gambia as the chosen country of this study is ranked as a low-income country located in mainland Africa (World Bank, 2019). The country has a total population of 2.2 million, comprising 50.4% females and 49.5% males as of 2018 (World Development Indicator 2019). 1.3 million lives in the urban area while 883 thousand of the total population lives in the rural area (World

Development Indicator 2019). The country is divided into various administrative regions, Banjul City Council, Kanifing Municipal Council, West Coast Region (Kombo North, South, East, and the Fonis), Lower River Region (Mansa Konko), North Bank Region (Kerewan), Central River Region (Janjanbureh) and Upper River Region (Basse) (The Gambia, 2019). The population is made up of several ethnic groups, about one-third of the total population are Mandinkas, follow by Fulas, Wollof, Jolas, and Sarahulehs, whiles her languages are English (official), Mandinka, Wolof, Fula(Pulaar), Jola, and other indigenous languages (The Gambia, 2019). About 95% of the total population are Muslims, 4% Christians and the remaining 1% are traditional believers and free thinkers (The Gambia, 2019).

It has a youthful population of almost 60% of the total population with a 5.2 number of children born to a woman as of 2018 (World Development Indicator 2019). In the Gambia, this high fertility rate undermines one's social factors, individual thought, behavior, and cultural implications for any couple who becomes a victim of infertility (not being able to get pregnant despite having frequent, unprotected sex for at least a year for most couples) (Mo, 2017). This is not surprising, because the Gambia is a society with deep-rooted traditions with Islamic religion playing a major role in the life of her people thus decisions regarding marriage, puberty, virginity, sex, pregnancy, breastfeeding, and childbirth are often influenced by culture and religion (IFHHRO, 2017).

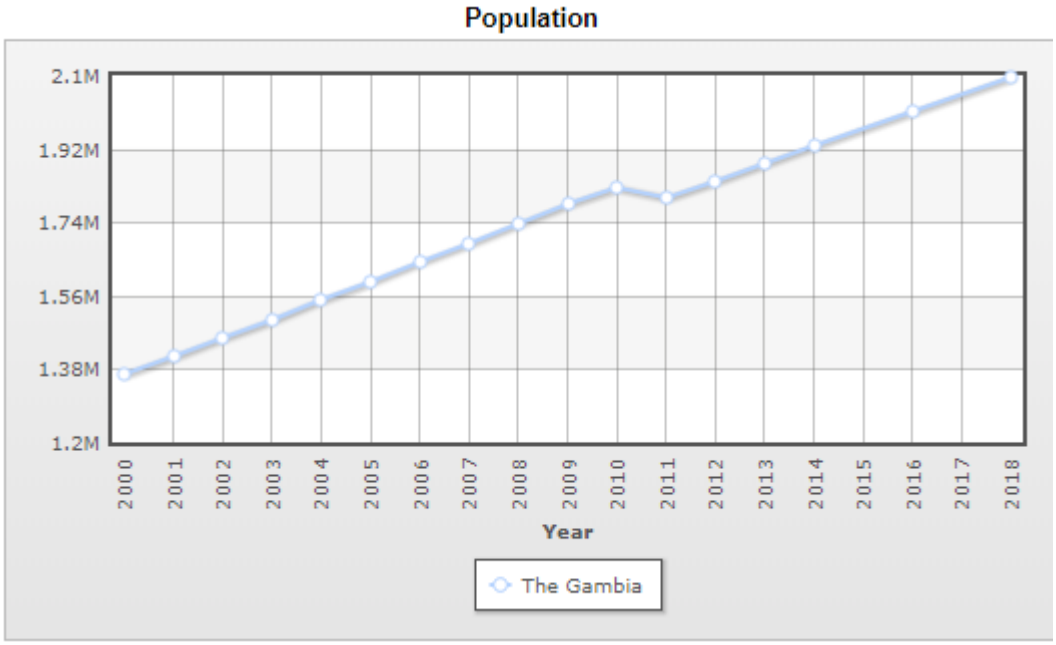
The total literacy rate is about 55% which comprised of more males than females with a traditional extended family structure as the most common type of family unit structure where men can marry up to four wives (The Gambia 2019).

Figure 2: Population growth rate trend



Source: https://www.indexmundi.com/the_gambia/#Demographics

Figure 3: Population trend



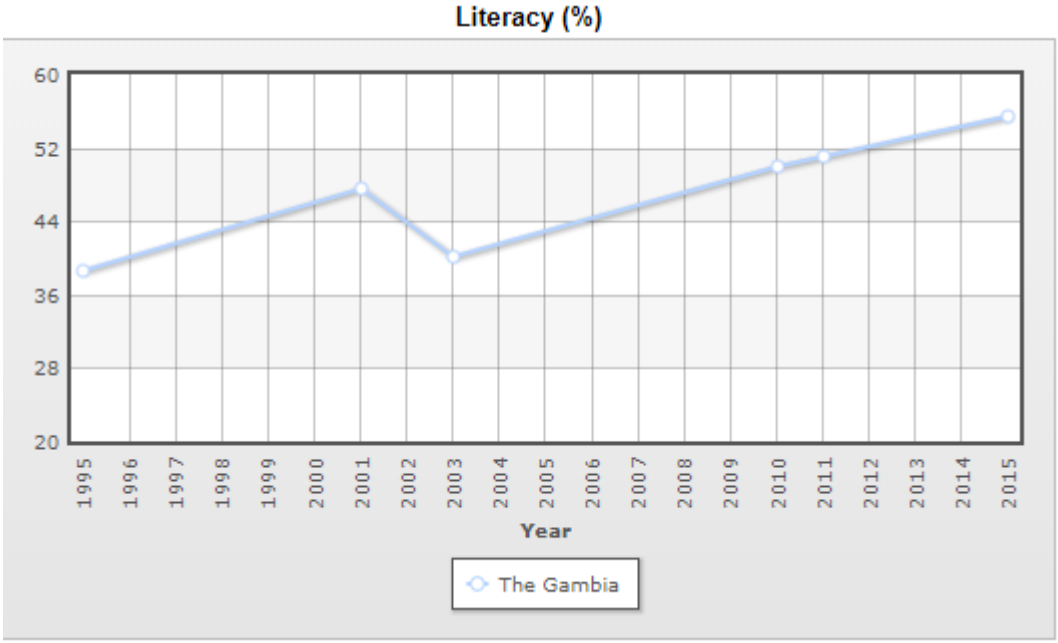
Source: https://www.indexmundi.com/the_gambia/#Demographics

Moreover, the education statistics in the Gambia UNESCO (2014) show that females have a higher primary school gross enrollment ratio compared to males as of 2010. While the gross enrollment ratio for males stood at 78.75, the gross enrollment ratio for females stood at 80.83 UNESCO (2014). Notwithstanding, UNICEF (2019) using the Gambia DSH data 2013 also indicated that the school completion rate for males is 50, for females is 46, for urban dwellers are 62, and for rural dwellers is 26. However, this shows that there is still a disparity between these groups in the school completion rate. Males took the lead in the gross enrollment in the education of both secondary and tertiary levels of a ratio of 3.21 more than that of the female ratio of 2.24 as of 2012, despite females having the highest number of enrollments in primary level UNESCO (2014). Due to certain factors, women are usually unable to complete their education and will end up dropping out of school. Such factors might include early marriage, gender bias (boys given more priority to go to school than girls), or teenage and unintended pregnancies. According to UNFPA (2017), 19.4% of the total Gambian population get pregnant before 18 years.

Based on these factors, the government of the Gambia took it upon itself to come up with certain policies that will serve the best interest of girls and women to avoid or reduce the above-mentioned challenges that girls in the Gambia have been facing since the premodern era. In 2016, the government of the Gambia amended the children's Act of 2005 by banning child marriage offenses (Children's

(Amendment) Act, Cap. 45:01 Vol. 7 Laws of The Gambia 2009). This amendment is due to the challenges faced by Gambian girls getting into marriage at the age of 15 and 16 years regardless of the continuous sensitization activities in their societies to detach from such (CEDAW Report Gambia NHRC 2019). Section 3 of the Children (Amendment) Act 2016 defines child marriage as "a marriage contracted between a child and an adult or a child and another child." Section 24(1) of the Children's (Amendment) Act (Cap. 45:01 Vol. 7 Laws of The Gambia 2009) further provides that: a child shall not be capable of contracting valid marriage and child marriage is prohibited.' Section 24 (2) states; 'A parent, guardian, or any other adult who willfully contracts, causes or forces a child to contract a marriage commits an offense and is liable on conviction to imprisonment not exceeding Twenty Years (section 24 (3)(b) of the Children's (Amendment) Act 2016).

Figure 4: Literacy rate trend



Source: https://www.indexmundi.com/the_gambia/#Demographics

Additionally, the Gambian government also committed itself to provide a voluntary use of family planning methods to the public and it reads: 'The government of The Gambia (GoG) is committed to increasing access to family planning (FP) and other sexual and reproductive health (SRH) information and services to all Gambians who need it, including adolescents and youth by 2020. This will be achieved by ensuring commodity security, availability of service providers, and equipment at all service delivery points, regular supportive supervision, monitoring, and evaluation' (Gambia Family Planning 2020). Looking at early marriage and teenage pregnancy as determinants of fertility in the

Gambia, I believe with the above laws in place it will help reduce the number of births per woman over time, especially during adolescence and will as well help to improve their education level and reproductive health. Early marriage and education are interrelated since the higher a person's education level, the less likely the person will get married early. Looking at early marriage as a factor of early childbearing often causes increased health risks to adolescent mothers and reduces their education and employment opportunities in the labor market that adolescent girls might have had otherwise (Sulemana et al., 2018).

1.2.Study Objective

Based on the above conclusion of previous researchers on the population trend in Sub-Saharan Africa due to a high fertility rate, it triggered me to choose this topic in other to examine whether educating women can be used as a channel in discouraging high fertility rate in the Gambia. Thus, I believed one of the best and fastest ways to control population growth is by empowering women through education as an opportunity cost to lessen their fertility rate. This will as well contribute to human capital formation in which Becker et. al, (1990), highlighted that societies with less human capital often choose to have large families and invest little on each member whiles societies with ample human capital will choose small families and invest heavily on each member leading to a higher rate of return on a human capital investment relative to the rate of returns on children. Thus the ones with large families will have little human capital whiles the ones with small families will have a growing human and physical capital (Becker et. al, 1990)

In this regard, this research aims to analyse whether empowering women through education can lead to a decline in population growth through a reduction in the number of children per woman in The Gambia. This study is of high importance because, during the pre-modern era, girls were not given the priority to go to school compared to boys due to some religious, cultural, and economic reasons in the Gambia. However, during the modernization of societies, things have changed due to the promotion of gender equality, women are now sent to school and we have realized an improvement in women's education in this new millennium in The Gambia. Thus, this research will tend to explore ***to what extent does this improvement in women's literacy impacted the fertility rate of women in The Gambia?*** This result will be produced by employing a cross-sectional data, Gambia DHS 2013 to retrieve results.

1.3. Research question

As mentioned earlier in the paper, the impact of women's education on fertility is crucial because women would be the right and fastest channel to promote fertility decline. Conducting this research in Sub-Saharan Africa, The Gambia is of high importance since the region is married to a high population with the highest fertility rate compared to other regions of the world that goes with a modest death rate (Cleland & Zulu, 2011). Kim (2016), strongly argued the importance of education especially female education as a key variable that influences women's fertility. In this regard, he believed better-educated women tend to have better jobs and earn higher incomes, takes better care of their children at home, and have a better knowledge of contraceptive use He highlighted three important mechanisms that influence the fertility decision of educated women compared to uneducated. Firstly, he pointed out that educated women often choose to have fewer children because of higher income and higher income foregone due to childbearing. Secondly, he emphasized that educated women give better care to their children thereby increasing their children's human capital thus reduces the economic need to have more children. Finally, he outlined that educated women have a better knowledge of contraceptives use compared to uneducated women. He concluded that in both developed and developing countries, women who attend school have different ideas on family size than those who do not attend school. Thus, educated women have fewer children than uneducated. In this regard, this paper will tend to explore the research question, *to what extend does women's literacy impact fertility?*

1.4. Scope

Hence, this study is designed to examine the hypothesis that women education through the policies and institutions set up by the government of the Gambia will have a positive impact on women fertility and girls empowerment especially in the fight against early marriage and teenage pregnancy and most importantly the advocating of the use of family planning methods. As a result, this thesis will be related to previous research done by Sulemana et al., (2018), Kanteh and Palamuleni (2019) and Osili and Long,(2007) who used mother's education, women status, and female schooling to model for fertility (number of children). They found out that empowering women through education reduces the number of children per woman. Similar results were also found by Ainsworth (1989) and Upadhyay & Karasek, (2012) who used a panel data with OLS regressions on some Sub-Saharan African countries.

However, this study differs in techniques. In terms of techniques, this paper employed a cross-sectional study using a negative binomial distribution. A comparison was done between OLS, Poisson and negative binomial and the result of the negative binomial came out the best for the Gambia DHS data employed. This study has the advantage to be the first to write on the said topic in the Gambia. Thus, the results will serve as a guide for policymakers when making decisions.

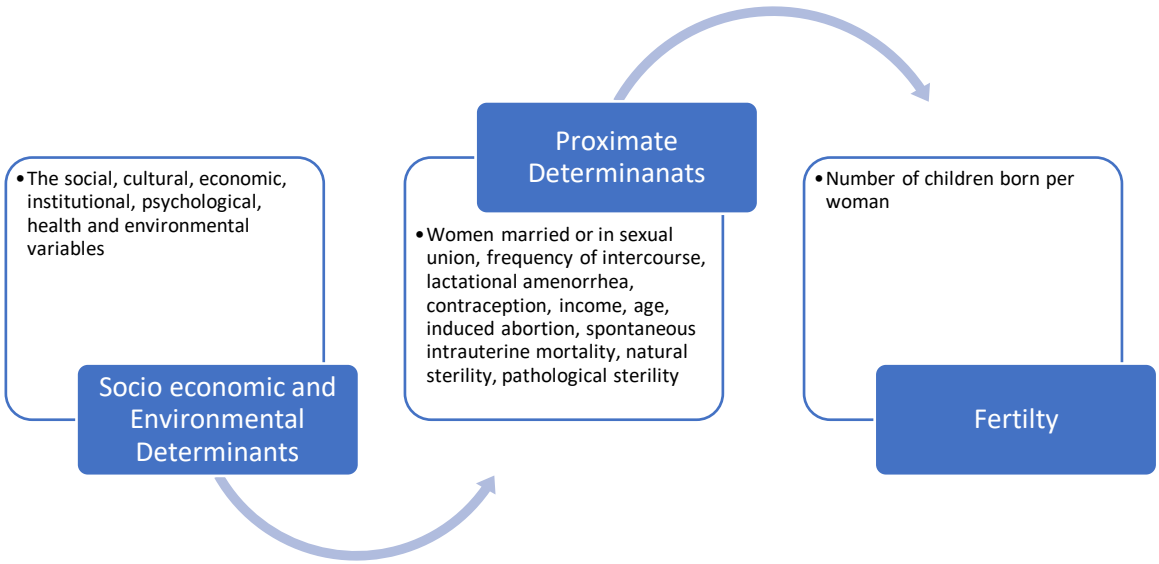
Hence, the paper is structured as follows: Chapter 2 is the literature review and research question which addresses the relationship between education and fertility in Sub-Saharan Africa. Chapter 3 examines the methodology; chapter 4 interprets the regression results retrieved from the DHS data. Chapter 5 concludes with recommendations for policymakers.

Chapter 2: Literature Review

2.1. Conditions and Determinants of fertility

Fertility transition cannot be addressed without discussing the causes of the transition commonly known as determinants of fertility. These determinants have been described by various authors such as Davis and Blake (1956), Bongaarts and Potter (1983), who group the determinants of fertility into two categories, proximate determinants, and socio-economic and environmental determinants. According to Bongaarts (2015), the socio-economic and environmental or background factors most always transit through the proximate determinants to influence fertility. These proximate determinants consist of the biological and behavioural factors that include a proportion of women married or in sexual union, frequency of intercourse, lactational amenorrhea, contraception, income, age, induced abortion, spontaneous intrauterine mortality, natural sterility, pathological sterility, etc (Bongaarts et al, 1984). Notwithstanding, the socio-economic and environmental determinants consist of the social, cultural, economic, institutional, psychological, health, and environmental variables (Bongaarts et al,1984).

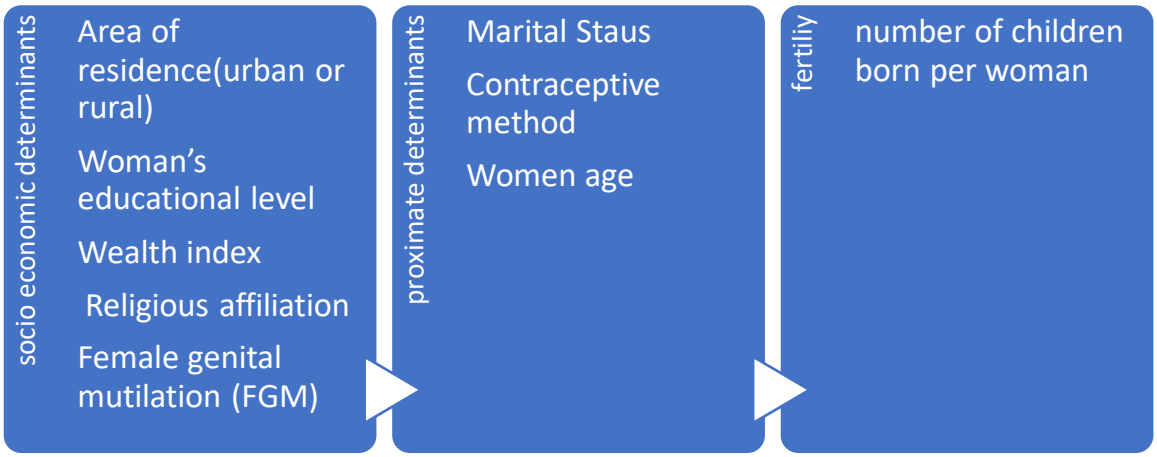
Bongaarts Framework on the determinants of fertility



Source: author's construct of the Bongaart's framework

2.2. Theoretical Framework

Author's framework on the determinants of fertility



Furthermore, as mentioned earlier the determinants of fertility are many and context specific. The above variables will be determinants of fertility for this work and will be used to know their impact on fertility.

Area of residence: The area of residence in this study represents the urban and rural dwellers in the Gambia. This variable is employed because I believed it is one variable that will influence fertility. Whiles the gap between rural and urban fertility transition rates has been widening for most developing countries, the causes and nature of these fertility differentials between these two areas are not well understood (Muhidin and Ledent, 2005). According to Yousif (2001), urban women have more access to the media, health, modern jobs, education, family planning methods to name a few than their rural counterparts. The majority of whom are still married to the ideology of traditional norms and practices. Thus, it is part of this study's objective to address this problem of what causes the fertility differentials between urban and rural dwellers in The Gambia.

Women's educational level: In a nutshell, according to the various works of literature I sited in this study, indicated a negative relationship between women's education and fertility. Given that the more educated a woman is the lesser the number of children she will have compared to the uneducated women. However, I believed the correlation and causations of fertility differential, between educated

and uneducated vary across countries. Thus, this study will be examined to what extent does women's education affects fertility in The Gambia. This is discussed in detail in the research question.

Wealth index: The wealth index according to the DHS program, accounts for a household's ownership of selected assets, such as electronics, materials used for housing construction and type of water access, and other sanitation facilities. Thus, employing this variable in this study will allow for the identification of problems particular to the poor such as unequal access to health care and other social amenities which are seen as determinants of fertility. Hence knowing the impact of this variable on fertility will help the government in making decisions regarding decentralizing public goods especially in rural areas where poverty is higher compared to urban. Masanja et al., (2016) conducted a study on the declining effect of fertility on household socioeconomic conditions and found that fertility decline in Tanzania led to a demographic dividend at household levels. Thus, he recommended for equal improvement of women empowerment in both rural and urban areas for an improved and sustained living standard.

Religious Affiliation: Most of the developing societies in their early life of fertility transition especially Sub Saharan Africa has observed religious fertility differentials by focusing more on Muslin-Christian fertility differentials. This study varies across countries since some have a population of more Muslims than Christians and others vice versa. Looking at the effect of religious affiliation on fertility in the Gambia is paramount because 95% of the total population are Muslims whiles only 4% are Christians thus this will help to know whether religion is one factor contributing to the high fertility rate (Agadjanian & Yabiku, 2014).

Female Genital Mutilation: FGM also knows as Female Genital Circumcision is a traditional and religious practice in Africa to reduce the sexual desire of girls. The motive of reducing this sexual desire is to prevent young girls from having sex before getting married. According to the world bank (2019), The Gambia has a 74.9% FGM prevalence as of 2013. Several studies have been conducted on the fertility differential between circumcised women and uncircumcised in Africa. However, the results of the fertility differentials vary according to countries. A study conducted by Larsen & Yan (2000) shows that in Cote d'Ivoire and Tanzania, TFR is higher within the circumcised women than the uncircumcised women whiles in the Central African Republic, it is higher for the uncircumcised women than the circumcised. Hence since the impact of FGM on fertility is context-specific, this paper will examine the fertility differential among women who have undergone FGM, women who

haven’t undergone and women who did not know their FGM status. This result will help the government of The Gambia in making policies regarding FGM concerning population control.

Marital Status: I believed the marital status of women in a population is an important variable in researching the determinants of fertility in developing countries since changes in marital compositions can lead to fertility variations. According to David and Blake, the relationship between fertility and marriage life is a function of contraceptive use, childbearing outside marriage, divorce, and remarriage. Hence is ideal to know the extent to which childbearing is affected by factors determining the exposure to sexual relations within, after, and between unions (Kanjanapan, 1985).

Contraceptive Method: Contraceptive methods also known as birth control methods is intentional prevention of pregnancy by interrupting the normal process of ovulation, fertilization, and implantation through the use of different approaches such as sexual practices, chemicals, drugs or surgical procedures (Jain & Muralidhar, 2011). The reason for choosing this variable is to know how effective contraceptive methods are in birth control for both modern and traditional users. However contraceptive use among women depends on the effect their choice of method will have on their reproductive system and their ability to childbearing in the future (Wylie & Gebbie, 2002)

Women Age: Women's fertility often changes with respect to their age due to the common understanding that after menopause women are no longer able to become pregnant thus, they become fertile in their teenage (ASRM 2019). This implies that women in general experience a decrease in their reproductive system as they get older hence their fertility is usually expected to end almost 10 years before they reach menopause (Cooke & Nelson, 2011). Using this variable in this study will help to know the fertility differentials among different women aged groups which will guide policymakers with regards to which education policy suits what age group of women.

2.3. Relationship between women education and fertility

There is a plethora of literature from researchers on women's education and female fertility in Sub-Saharan Africa. Some researchers have indicated a negative relationship between fertility and women education whiles others highlighted that the relationship between the two can be understood by using other determinants of fertility to influence education. Ndjanmou, Bieda (2017) argues that the relationship between women's education and the fertility rate is not direct because Sub-Saharan Africa has been experiencing a significant improvement in education since the previous century but it only goes along with an insignificant decline in the number of children per woman. Furthermore, he

employed the Demography Health Survey Data (DHS) to run a research in different Sub-Saharan African countries to know the impact of education on fertility. In holding other factors constant, his result indicates that a person will have 0.11 fewer children after acquiring an additional year of education. This result is in accordance with the findings of other authors such as Ainsworth (1989) and Osili & Long, (2007).

Osili and Long (2007) also conducted a similar study between literate and uneducated women in Nigeria and concluded that educated women will have 0.26 fewer children with an additional year of schooling compared to the uneducated women (Osili & Long, 2007). Likewise, Sulemana et al., (2018) researched the relationship between education and fertility among Ghanaian women by using different data and techniques. They used cross-sectional data, Ghana Multiple Indicator Cluster Survey (MICS4) concerning a Poisson distribution model. However, their results are still like that of Osili & Long, (2007). Their Poisson regression results indicated little education effects on the expected number of children per woman. Their results indicated a negative relationship between education and fertility. Thus, their findings depict that an increase in years of education reduces the woman's expected number of children. The Poisson results also show a negative relation of some socio-economic and demographic characteristics of the woman fertility and the expected number of children (Sulemana et. al, 2018).

Ainsworth (1989) conducted a study in Cote devoir on the relationship between education and fertility and found that an additional year of schooling using an OLS regression will impact fertility by 0.11 fewer children (Ainsworth, 1989). Using the same DHS data, Upadhyaya and Karasek also conducted a study on four different Sub-Saharan African countries Guinea, Mali, Namibia, and Zambia, and concluded an inverse relationship between women empowerment and the number of children per woman (fertility) (Upadhyay & Karasek, 2012).

Furthermore, Shapiro (2012), also examined women's education and fertility transition in Sub-Saharan Africa and countries within that region and discovers that areas with low fertility tend to be areas with a high number of educated women. This research was addressed by exploring the DHS data on 28 different countries with various surveys and he examined the contribution of changes in women's education and other determinants of fertility to the continuous fertility transition in and within the region. He retrieves his result by using several variables to represent women's schooling that defines the number of years of schooling accomplished by the woman. The result from the study concludes that an increase in women's education was an important factor contributing to fertility

transition alongside a decline in infant and child mortality. Thus countries with a significant increase in women's education will realize a major decline in their fertility rate and a probability of even higher declines in the long run (Shapiro, 2012).

In addition, Shapiro and Tambashe also conducted a study and found a similar result. Their result shows that the fertility gap tends to broaden between educated and uneducated women as one attained more education especially secondary education than the other (Shapiro & Tambashe 1999). Clenland (2002) highlighted in his study that as women start experiencing a decline in their reproductive trend, fertility differrentials due to education starts to broaden. Thus, the uneducated are always the last to encounter a fertility decline at the initial stage and the educated are always the first to experience a fertility decline. However according to him, as fertility transition keeps unfolding, these differentials will begin to reduce until they converge at the end of the transition (Cleland 2002)

Similar research has been conducted in the Gambia by Kanteh and Palamuleni (2019) on the impact of women's status (husband's educational level, women employment status) on fertility. They employed the Gambia DHS data 2013 by using Poisson regression to examine the relationship between the status of women and the number of children ever born among married women of reproductive age groups (15-49 years). Their result shows a strong negative relationship between the improved status of women and children ever born. This implies that as the status of women improves, the number of children ever born decreases. Their results indicated that women married to educated men have fewer children compared to women whose husbands have no education. Thus concluding that a husband's education has an impact on the number of children born to the wife. This could be because the Gambia is having a male-dominated social system where women have little say in determining the number of children, when and what family planning method to use, hence in this regard, educated men will tend to have fewer children compared to uneducated who desire many to help in farming activities (IFHHRO, 2019). They also found other determinants significantly related to fertility in the Gambia such as age at first birth, age of the woman, age at first marriage, desired family size, type of marriage, polygamous marriage, choice of high fertility, and male child preference. Furthermore, their research identified four main channels through which improved status of women can reduce fertility and this includes improved educational attainment of women and their spouses, improved wealth status of households through poverty reduction, improved access and use of modern contraceptives to delay age at first birth and birth intervals and delay in age at marriage (Kanteh & Palamuleni, 2019). Thus, one can conclude that improving the status of women through

these channels should be the primary focus of the Government in implementing policies regarding fertility control in maintaining a low population.

Surveying the social determinants of fertility in the Gambia, co-opting of family members to help in raising children and social pressure are also found to have a significant effect on fertility according to research conducted by Sear et al., (2003) in The Gambia. However, looking at changes in education, it has discouraged the traditional setting of being in an extended family after attaining a certain level of education. As one's level of education increases, they tend to acquire a formal job and move out of the family house after marrying a wife. The main thing that kept them in family houses is agriculture (farming) which is performed by people with very little or no education. Education is one thing that has inculcated civilization in the life of many Gambian couples and led to many staying alone and taking care of their children without any support from extended families. Looking at this responsibility of taking care of your children, lead to women having fewer children since there is no one to help in babysitting. This research was conducted in the rural Gambia on the effect of kin on women fertility using data collected by McGregor from four different villages in the rural Gambia between 1950 and 1974. Their study was based on the assumption that women can maintain a high fertility rate by assigning family members to help out in raising their children thus they employ longitudinal data collected from the rural Gambia to test the hypothesis that the presence of kin will influence the fertility rate of women.

Furthermore, their result shows that both the presence of the husband's mother and to some extent the husband's father raises the probability of a woman giving more births. This is because women often move to their husband's house after marriage, which is usually an extended family where the husband will be living with their parents. These parents would often help in babysitting their grandchildren which will give more room to the woman to have extra children since she does not do the babysitting alone in the presence of her in-laws. However, their study shows that the woman's parent did not affect her fertility rate neither her elder sisters nor her co-wives. It is assumed that this might be because she does not stay with her mother and elder sisters after married and there is hardly a good relation with a woman and her co-wives which might trigger both not to help each other in babysitting and other domestic chores. Their result did not also show any evidence that the woman's elder brother has any impact on her fertility but shows the reverse that with the presence of elder brothers, women tend to have lesser fertility. Thus, there was no correlation between the presence of women's fertility and elder children by acting as helpers to their younger women at home. Therefore their result concludes that the rising fertility in the presence of the mother in law may be as a result

of these women helping out their daughters-in-law in domestic chores and other subsistence responsibilities thereby giving their daughters-in-law a higher opportunity cost to having more children (Sear et al., 2003).

2.4. Estimation of Fertility using Negative Binomial distribution

Many authors have used negative binomial and Poisson distribution to model count data or fertility. We can use a Poisson model to estimate the number of children born to a woman by concentrating on fertility at a period (Winkelmann & Zimmermann 1995). Poisson captures non-negative discrete count data and its power to determine the probability of occurrence of events. But one main issue of Poisson stated by Li (2016) is the variance and mean of the explained/dependent variable are said to be equal in theory, but in practice the mean is not same as the variance, thus leading to inconsistency and inefficiency of the estimates of the model. Therefore, one way to check the validity of the results of a Poisson model is done by running a negative binomial model that is why this work used a negative binomial model. Asiki et al. (2015) noted that if there is equidispersion in the count response data, the Poisson and Negative binomial regression should end up the same.

Non-parametric and Parametric methods have been recorded to have useful applications in research in demographic works. Apart from being important when creating hypothetical rate schedules in projection and forecasting, the models also serve to solve complex data into smaller matrices (Schmertmann 2003; Peristera and Kostaki 2007). Several models have; therefore, been proposed to estimate fertility as the major determinant (of the three demographic variables namely, mortality, fertility, and migration,); of the size and structure of any population.

These models have fit excellently the population they are intended to model. Gourieroux (2000) stated that the Poisson model is part of the generalized linear model for regression analysis, it is used mostly to estimate and model contingency tables and count data. Greene (2008) gave addition to the fact that the Poisson model has few great assumptions, one of which is that it has the ability to model and estimate the log of the expected value of an independent variable through the use of unknown parameters. Given that the independent variable fertility follows a Poisson distribution, then the Poisson formula as

$$\log\big(E(Y)\big) = \lambda y$$

Chapter 3: Methodology

3.1 Methodology

This section shows the data source and variable description. It also presents the limitation and data regression with a statistical summary of some variables. The statistical distribution model used for data analysis and techniques for model comparison is also addressed and the reason for using the chosen model. The Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) are used for model comparison between the Poisson and Negative binomial models. AIC and BIC of a negative binomial **27311.69** and **27446.3** respectively showed a better fit to model the data compare to the Poisson model as seen in Table 3.

3.2 Data source

The data in this work are demography secondary data from the 2013 DHS data for the Gambia. The GDHS survey used a two-stage stratified sampling method, one method is a cluster selection method, with a total of 281 clusters (9038 urban and 17563 rural). The other method is the household selection procedure. 26 households were used per cluster that is 7306 households. However, this work used 62 clusters with the same number of households per cluster leading to 1612 households. The reduction is a reduced data size for analysis as a result of many missing observations in the variable FGM(g102). The age of women eligible for an interview is 15-99 years, with a total of 6189 women were used for analysis. The independent variables used in this study to check the fertility differentials are both socio-economic and proximate determinants. These involve region of residence(v024), area of residence (v025, urban or rural), educational level(v106), Religion(v130), Financial status(v190), wealth index(v191), contraceptive use(v313), marital
status(v501), and age of the woman.

Table 1: Descriptive Data

Variables	Descriptions
V001	Cluster number
V002	Household number
V024	Region of resident
V025	Area of residence, rural or urban
V106	The highest level of education the woman attains no education, primary, secondary (both junior and senior), higher.

V130	Religion: Islam 1, Christianity 2, traditional believers 99, free thinkers 7
V131	Ethnicity: Mandinka 1, Wolof 2, Fula 4,
V136	Total number of household members
V137	Number of infants or kids under 5 years in a household
V138	Number of women in their reproductive age in a household
V151	Sex of the household head
V190	The woman's financial or income level, whether the person is classified as poor, poorer, or poorest
V191	Wealth index of a household. Urban and rural specific wealth index
V201	Total number of children ever born/fertility rate
V218	Number of living children, subtract the number of children who die from the total number of children born
V219	Total number of living children including the unborn at that time (pregnancy)/fertility rate
V312	Current contraceptives method
V313	Type of contraceptive method, not using, traditional, modern, etc
V501	Marital status
V502	Whether the person is in a union or staying with a man
V732	Whether the woman is currently working or have worked in the past one year, 0 means no working, 1 worked for the past one year, 2 means currently working, 9 worked occasionally, 3 works seasonal
G102	Whether the person has gone through FGM or not.
B 11,	Preceding birth interval between kids. Excluding first and twins
HV220	The age of women eligible for an interview between 15-99 years
Source: Gambia DHS 2013	

Table 2: Summary Statistic

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Cluster	6,217	30.384	17.858	1	16	31	45	62
Household	6,217	13.337	7.631	1	7	13	20	26
Region	6,217	4.910	2.243	1	3	5	7	8
Residence Area	6,217	1.652	0.476	1	1	2	2	2
Education levels	6,217	1.420	0.781	1	1	1	2	4
Religion	6,217	1.148	3.516	1	1	1	1	99
Wealth Status	6,217	2.768	1.335	1	2	3	4	5
Wealth index	6,217	-12,284.540	79,105.550	-113,482	-70,179	-42,401	26,108	250,089
Fertility	6,217	5.325	2.419	1	3	5	7	13
Contraceptive Methods	6,217	1.228	0.789	1	1	1	1	4
Marital Status	6,217	2.102	0.553	1	2	2	2	6
FGM status	6,189	0.753	0.517	0.000	0.000	1.000	1.000	9.000
Woman's Age	6,217	49.316	15.605	16	37	48	60	99

Chapter 4: Model and Regression result

4.1. The negative binomial regression model

As a result of the limitation of Poisson distribution been one-parameter distribution, that is depending on only the mean μ, the distribution restricts the variance to equal the mean. However, count data used in economic applications generally are over-dispersed.

A practical example is this study with reference to the data used, the dependent variable (Total number of children(v201) has a mean of 5.33, variance of 5.85 and a standard deviation of 2.42. The standard generalization of the Poisson is the negative binomial (NB) model. Since the sample mean is less than that of the sample variance thus, a negative binomial model/distribution is used specifically to overcome over-dispersion or under-dispersion in the Poisson distribution.

The negative binomial distribution is a distribution function that models the number of failures in a sequence of independent and identically distributed Bernoulli trials before a specified (non-random) number of successes (denoted *r*) occurs. It is a discrete distribution function that can be used to model count data with the dispersion problem. Assuming $Y\ has\ a\ negative\ binomial(r,p)$. In a sequence of independent $Bernoulli(p)$ trials, then Y is the number of a trial at which r^{th} success occurs and p is the probability of success. where r is a fixed integer. Then $Y{\sim}nbin(r,p)$;

$$P(Y=y|r,p)=\binom{y-1}{r-1}p^r(1-p)^{y-r}\ for\ y=r,r+1,\ldots., \qquad (1)$$

It can also be defined in this form

$P(X=x)=\binom{x+r-1}{r}p^r(1-p)^x,\ x=0,1,\ldots..$ where x is the number of failures before r^{th} success. This formulation is statistically equivalent to equation (1). Therefore $X=Y-r$. The mean and variance of the distribution are:

$E(r)=\frac{xp}{1-p}$ and $Var(r)=\frac{xp}{(1-p)^2}$ respectively.

With a Poisson distribution, the mean and the variances are both equal ($\lambda=\sigma^2$): a condition (i.e., equidispersion) I am not sure how often this occurs in reality. So, a negative binomial should be more flexible as it does not have the assumption of equidispersion.

The coefficients can be interpreted in the log (y) scale and the incidence rate ratio (IRR) which have an additive and multiplicative effects respectively in the dependent variable (fertility) scale.

The dependent variable is predicted with a linear combination of independent variables with a log. Given as;

- **Multiple models**

$$\log(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + \cdots + \beta_p X_p + \epsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\log(fertility) = \beta_0 + \beta_1 residence + \beta_2 education + \beta_3 Mother's\ Age + \beta_4 Wealth\ index + \beta_5 Religion + \beta_6 Contraceptive\ use + \beta_7 FGM + \beta_8 Marital\ Status + \epsilon \ldots\ldots\ldots (3)$$

- **Interpretation of the Regression Estimate**

Taking the exponent of the model (3), for interpreting the regression coefficient. This implies for the incidence rate ratio. Incidence Rate Ratio (IRR), is used to interpret the results from the negative binomial model used in this work. It is a ratio based on the rate of incidence of counts, (Hilbe and Greene, 2007).

$$Y_i = exp^{(x_i'\beta)} \text{ or}$$

$$Y = e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + \cdots + \beta_p X_p + \epsilon)} \quad \ldots\ldots\ldots (4)$$

y_i is the dependent variable (fertility)

x_i' is the vector of independent variables

β is the coefficient estimate of the independent variables

- For a positive coefficient, the transformed log value (**incidence rate ratio**) will be greater than one, meaning that the event's number of interests will increase.
- Given a negative coefficient, the transformed (**incidence rate ratio**) will be less than one, meaning the number of events of interest will decrease.
- If an estimate is zero, then the transformed log value is one, meaning that the coefficient does not change the outcome or has an effect on the outcome.

(1) Continuous independent variables

For continuous variables, if $X = c$, (c is constant); then the average number of events is given as; $Y = e^{\beta_0} e^{(\beta_1)X}$, then an increase in one unit of X, $X = K + 1$, will give the transformed log as;

$$Rate\ Ratio = \frac{Y\ when\ k+1}{Y\ when\ K} = \frac{e^{\beta_0} e^{(\beta_1)X} e^{\beta_1}}{e^{\beta_0} e^{(\beta_1)X}} = e^{\beta_1}$$ as the incidence rate ratio.

(2) For categorical independent variables

Categorical variables with j levels, there is always a reference group, then have $j-1$ dummy variables and $X_i = \begin{cases} 1\ if\ in\ level\ i \\ 0\ otherwise \end{cases}$

- **Dependent variable**

The response variable is count data of the number of children born to a woman. Ranging from 1 to 13 as the maximum number of children born by a woman. 4.90% of women had given birth to one child, 8.53% to two children each, to 0.21% women to 13 children each, as shown in table 5.

- **Independent Variables**

Estimation of the dependent variable (fertility) equation (2). The independent variables used in the regression model are as follows; area of residence (urban or rural), woman's educational level, woman's age in years, wealth index, religious affiliation, contraceptive method, female genital mutilation (FGM) and marital status. Categorical independent variables are; area of residence in which the urban represents the reference group. Women's education level comprised of, no education, primary education, secondary education, and higher education, where women with "No education" represent the reference group. Religious affiliation includes Christianity, Islam, and other religious sections, where Christianity is the reference level. The contraceptive method involves women not using contraceptives, the Folkloric method, a traditional and modern method, and was "not using contraceptive" was used as the reference group. Female genital mutilation (FGM) were women who undergone FGM women who did not experience it was made the reference group. Marital status includes women not married, married, living with partner, widowed, divorced, and separated, however, women "not married" represents the reference group. The continuous independent variables are woman's age in years ranging from 19 to 99 years and wealth index.

The coefficients are interpreted using the incidence rate ratio as explained above.

- **Expected Results (Theoretical Framework)**

Hypothetically, we expect the sign of a mother's level of education to be negative and significant. This is because women with more educational levels tend to have fewer children ceteris paribus, (Sulemana et al., 2018). A priori we expect the sign of women in the rural area to be positive in

relation to women living in the urban and be significant. This is because in many African settings the poor live in rural areas and believe many children are needed to help with farm work or a belief some may die as a result of poverty so many will help compare to women who live in the urban area ceteris paribus. At the outset, we expect the sign of mother's age negative. This is because as women ages, they are less likely to have children as a result of reaching their menopause ceteris paribus. Initially, this paper expects the sign of wealth index to be negative ceteris paribus. This is because as the wealth of a household increases parents tend to plan for a better future, this may not apply in many Africa societies. A priori this paper expects the sign for religious affiliation for Islam and traditional believers to be positive ceteris paribus. This is because a Muslim man is permitted by Islam to marry up to four wives and the traditional believers are not also restricted to the number of wives to marry compared to their Christian counterpart who are restricted to one wife as seen in Sulemana et al., (2018). A priori this study expects the sign of contraceptive method to be negative and show some significant level holding other things constant. This is because contraceptives can help in the spacing of children which might reduce the number of children expected to be born. At first the paper expects the sign of female genital mutilation (FGM) for women who have not undergone female genital mutilation to be positive compare to women who did female genital mutilation. This is because female genital mutilation is a traditional concept use by many Africa tribes for controlling sex before marriage, thus the cutting (mutilation) is to reduce their sexual desire. Originally, this paper expect the sign of marital status for women to be positive compare to women not married and also because of early marriage and teenage pregnancy was very common in the Gambia due to religious and traditional beliefs.

Figure 5: Model comparison

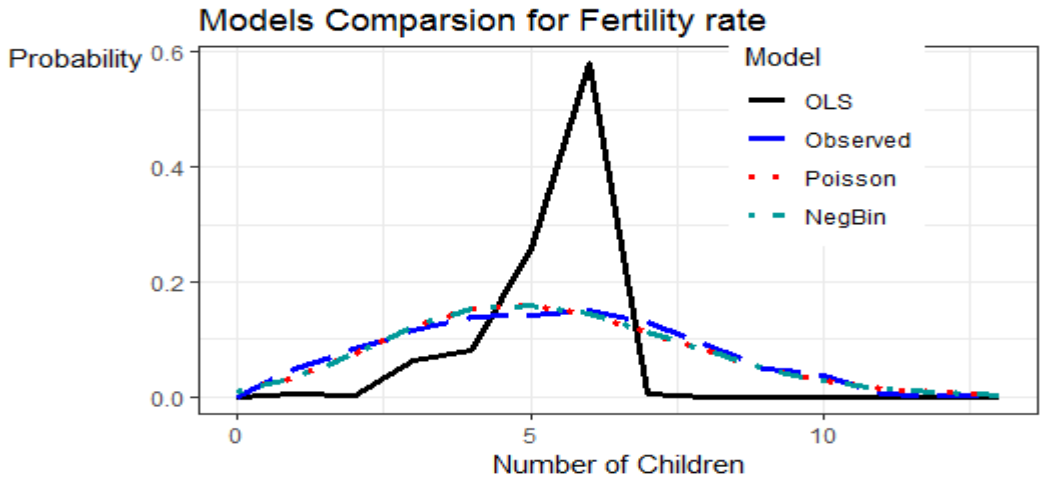


Figure 5 defined as the "Models comparison for fertility" provides a comparison between a negative binomial, Poisson distribution, and linear model of fertility (number of children per woman) count data. Although the probabilities associated with the count of several children or fertility is the same between Poisson and negative binomial compared to the observed outcome, the mean and variance of the distributions are not the same. The objective of the negative binomial is the same as the Poisson distribution to estimate and model the association between controls and the likelihood of certain count response variables. The negative binomial takes into consideration the problem of over-dispersion in the data when the mean is greater than a variance.

4.2. Regression Results interpretation of equation 4

The expected log estimates and incidence rate ratio estimates(exponentiated log coefficient) of equations 3 and 4 are presented in tables:3. The results are interpreted with respect to the incidence rate ratio in column 2 of table:3 to identify which predictors are accountable for the variation of the dependent variables. The categorical independent variables are treated as factors and dummy/binary variables were treated in descending order with the lowest coded category being used as the reference level.

The variable Educational level and area of residence, which are categorical variables are both statistically significant at 1 percent level. But the residence area influences fertility positively. The rate ratio shows the incident rate for women residing in rural areas is 1.06 times the incident rate for the reference group (urban = 0) or for every unit change in residence type the IRR increase by 6.3% for rural residents compared with no education, adjusting for educational level, religion, contraceptive method, FGM and marital status. All educational levels have a negative effect on fertility since the incidence rate ratio values are less than 1. primary, secondary, and higher education levels indicate they have 0.89,0.67- and 0.68-times lower incident rate compared to the reference level (No education). This estimate for educational level agrees with much literature on fertility. The result for the educational level is consistent with various findings in Africa, eg (Osili and Long, 2008; Zanin, Radice, and Marra, 2015). Showing an additional year of education is negatively related to the mother's expected number of children. The age of the woman is insignificant and Wealth index is statistically significant at 1 percent level, but they do not show any effect on fertility at any unit change. Religion for Islam and tradition indicates a positive influence on fertility by an incident rate of 1.10 and 1.34 times the incident rate for the reference group (Christianity) holding other things constant. The contraceptive method for the folkloric and modern method is significant at 5% and 1%

level, while folkloric and traditional method indicates negative influence on fertility, indicating that the incident rate for the folkloric and traditional method is 0.71 and 0.89 times lower than the incident rate for the reference group(Not using contraceptive) respectively. While modern method shows an unexpected direction of a positive effect on fertility with an incident rate of 1.10 times the incident rate for the reference group, the outcome for the modern method maybe as a result of less knowledge about the modern method that can lead to the wrong usage hence leads to unexpected pregnancies.

The categorical variable FGM for women who do not undergo FGM shows a positive influence on fertility and is statistically significant, while women who do not know their FGM status indicate a negative effect on the number of children born to a woman. In most African settings especially in The Gambia, women who responded as they don't know their FGM status are mostly women who underwent FGM. This is so because according to culture one should not disclose such information to people unknown to you

The categorical variable marital status was coded into six levels to represent the various categories with 'not married' being treated as the reference variable. All the categories of marital status are significant at 1% level, and all levels show a positive effect on fertility with an incident rate for married, living with partner, widowed, divorced and separated are 2.72, 2.98, 2.63,2.30 and 2.41times the incident rate for the reference group (not married) respectively.

Table 3: Negative Binomial Regression Results

	Dependent variable:	
	Fertility	
	logit Coef	Incidence Rate ratio
	(1)	(2)
Constant	0.662*** (0.067)	1.940*** (0.067)
Residence[Urban]		
Rural	0.061*** (0.017)	1.063*** (0.017)
Education Level[No Education]		
Primary.edu	-0.114*** (0.018)	0.892*** (0.018)
Secondary.edu	-0.404*** (0.022)	0.667*** (0.022)
Higher.edu	-0.389*** (0.042)	0.678*** (0.042)
Mother's Age(Years)	-0.0002 (0.0003)	1.000*** (0.0003)
Wealth index	-0.00000*** (0.00000)	1.000*** (0.00000)
Religious Affiliation[Christianity]		
Islam	0.093** (0.037)	1.097*** (0.037)
Traditional	0.292*** (0.008)	1.339*** (0.008)
contraceptive method[Not Using]		
Folkloric method	-0.347** (0.168)	0.707*** (0.168)
Traditional method	-0.117 (0.090)	0.889*** (0.090)
Modern method	0.090*** (0.019)	1.095*** (0.019)
FGM status[Did FGM]		
No FGM	0.045*** (0.013)	1.046*** (0.013)
Unknown	-0.080 (0.126)	0.923*** (0.126)
Marital Status[Never in union]		
Married	0.999*** (0.063)	2.715*** (0.063)
Living with partner	1.091*** (0.100)	2.977*** (0.100)
Widowed	0.967*** (0.069)	2.629*** (0.069)
Divorced	0.832*** (0.075)	2.297*** (0.075)
No longer living together/separated	0.880*** (0.122)	2.412*** (0.122)
Observations	6,189	6,189
Log Likelihood	-13,636.840	-13,636.840
theta	53,687.400 (145,583.300)	53,687.400 (145,583.300)
Akaike Inf. Crit.	27,311.690	27,311.690
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 4: Model comparison of the negative binomial and Poisson distribution

	Poisson	**Negative binomial**
AIC	27463.1	27311.69
BIC	27437.5	27446.3

Model comparison of the negative binomial and Poisson Model based on AIC and BIC in Table 4 shows the Negative binomial has a better AIC which is lower than that of the Poisson and a better

BIC again which is higher than that of a Poisson BIC model. This gives evidence that the negative binomial model comparatively better fit to estimate the differential fertility effect than the Poisson model.

Figure 6: Residual square Plot

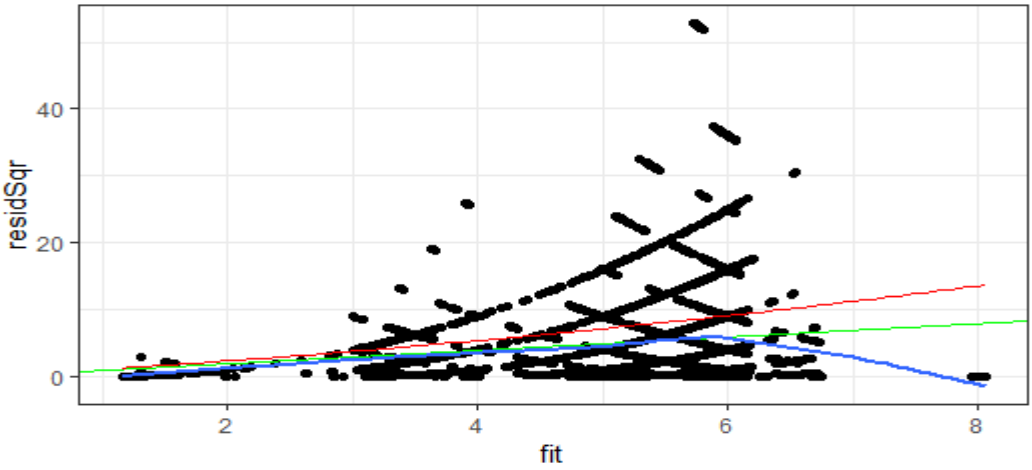


Figure 6 shows the Residual square plot for negative binomial, Poisson, and observed. Thus, the red line represents the negative binomial model and the green line represents the Poisson model which almost the same as the observed with the green line.

Statistics summary

Table: 5 Frequency Summary Table

	Freq	% Valid	% Valid Cum.	% Total	% Total Cum.
1	303	4.90	4.90	4.90	4.90
2	528	8.53	13.43	8.53	13.43
3	723	11.68	25.11	11.68	25.11
4	852	13.77	38.88	13.77	38.88
5	870	14.06	52.93	14.06	52.93
6	930	15.03	67.96	15.03	67.96
7	805	13.01	80.97	13.01	80.97
8	560	9.05	90.01	9.05	90.01
9	297	4.80	94.81	4.80	94.81
10	240	3.88	98.69	3.88	98.69
11	44	0.71	99.40	0.71	99.40
12	24	0.39	99.79	0.39	99.79
13	13	0.21	100.00	0.21	100.00
<NA>	0			0.00	100.00
Total	6189	100.00	100.00	100.00	100.00

Table 5 and figure 7 shows the frequency distribution and summary of the fertility per woman. Showing 303 women have 1 child and 13 women have 13 children which are the maximum number of children born per woman in the data used for this work analysis.

Figure 7: Histogram of Fertility

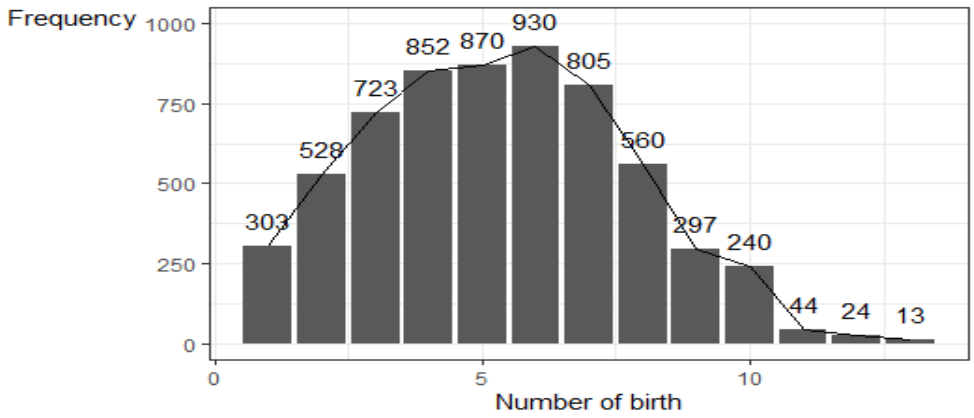


Table 6: Region of residence

	Banjul (N=342)	Kanifing (N=679)	Brikama (N=1257)	Mansakonko (N=359)	Kerewan (N=945)	Kuntaur (N=776)	Janjanbureh (N=633)	Basse (N=1226)	Total (N=6217)	p value
(Fertility Rate)										< 0.001
Mean (SD)	3.871 (1.702)	4.638 (2.133)	5.158 (2.330)	6.164 (2.759)	5.751 (2.571)	6.015 (2.541)	5.591 (2.350)	5.132 (2.221)	5.325 (2.419)	
Range	1.000 - 7.000	1.000 - 10.000	1.000 - 10.000	1.000 - 12.000	1.000 - 12.000	1.000 - 13.000	1.000 - 10.000	1.000 - 10.000	1.000 - 13.000	
Age										0.229
Mean (SD)	48.401 (15.954)	49.203 (15.127)	49.155 (15.598)	48.103 (15.672)	50.372 (16.539)	49.170 (15.302)	49.984 (15.087)	49.086 (15.449)	49.316 (15.605)	
Range	20.000 - 95.000	16.000 - 95.000	18.000 - 99.000	19.000 - 99.000	16.000 - 98.000	19.000 - 95.000	19.000 - 95.000	16.000 - 96.000	16.000 - 99.000	
v191 **(Wealth index)**										< 0.001
Mean (SD)	124986.988 (58151.868)	93794.611 (68371.794)	4418.169 (82173.271)	-61149.880 (28978.377)	-42654.099 (51516.640)	-64759.191 (24956.803)	-53460.700 (32578.606)	-34261.038 (42068.298)	-12284.541 (79105.549)	
Range	5425 To 231937	-47407 To 239119	-107677 To 250089	-99613 To 76805	-110515 To 174106	-110251 to -2604	-107212 to 33707	-113482 to 100453	-113482 to 250089	
g102 **(FGM)**										< 0.001
N-Miss	7	1	7	0	13	0	0	0	28	
Mean (SD)	0.597 (0.491)	0.667 (0.472)	0.789 (0.408)	0.975 (0.157)	0.722 (0.527)	0.593 (0.894)	0.512 (0.500)	0.989 (0.102)	0.753 (0.517)	
Range	0.000 - 1.000	0.000 - 1.000	0.000 - 1.000	0.000 - 1.000	0.000 - 9.000	0.000 - 9.000	0.000 - 1.000	0.000 - 1.000	0.000 - 9.000	

Table 6 depicts the summary of the region of residence showing the mean, standard deviation, range, and p values of the descriptive statistics in relation to fertility, age, wealth index, and FGM.

CHAPTER 5: CONCLUSION

This paper seeks to determine the impact of women's literacy on fertility in The Gambia using the GDHS 2013. The same data was used by other researchers to conduct a study in the same region with similar topics. Whiles others found that there was no relationship between women's education and total fertility rate, some found that there was a correlation between the two but not very significant. To check the fertility differentials, this study used Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) for model comparison between the Poisson and Negative binomial models. The AIC and BIC of a negative binomial show a better fit to model the data compare to the Poisson model as indicated in table 4 above. Thus, the study employed negative binomial to retrieve results. In using the negative binomial model, this study uses fertility (number of children per woman) as the dependent variable with some socio-economic and proximate determinants as independent variables as indicated in table 1 above.

However, the negative binomial regressions result indicates that our categorical variables, educational level, and area of a resident are negative and statistically significant. That is, women with primary, secondary, and higher levels of education will have a lower number of children compared to women with no education. Whiles the variable area of residence can be interpreted as a woman in the rural area has a probability to have more children compared to women in the urban area. Our continuous variable age translated that an additional year on a woman's age will lower the expected number of children she will have which makes sense. This can be explained that as women age, they get closer to their menopause which affects their total number of children. The variable Wealth index showed a significant and negative relationship with fertility, given that an additional wealth of a household or woman will lower their expected number of children. Also, it was not surprising that women who were affiliated with the Islamic religion are positively related to the expected number of children by 0.093 in the negative binomial result. In the Gambia, most Islamic communities are noted for large family size and household since a man can marry up to four wives compare to their Christian counterparts, the reference group. Traditional/other religious affiliates are positively and significantly related to the expected number of children with a probability of 0.292. The estimates for religious factors Islamic and traditional women have a higher chance of having a higher number of children compare to women who are Christian (reference group 1). The use of contraceptive methods for folkloric and traditional methods are insignificant and negatively associated with the expected number of children for a woman. They showed that women using this method are expected to have a

lower number of children compared to women not using any method by 0.347 and 0.117, respectively. However, the use of the modern method shows a positive and statistically significant relationship to fertility, this outcome maybe because of less knowledge about the modern method that can lead to the wrong usage of the contraceptives which may lead to unexpected pregnancies. Another categorical variable FGM gives a result showing women who do not do FGM have a higher number of children compared to the reference group 1 (women who undergone) FGM. This is not also too surprising since FGM is a traditional method used to help girls control their sexual desire by preventing them from having sex or children out of marriage. While women who do not have any knowledge of whether they went through FGM or not, have a lower number of children compared to reference group1(women who did FGM). Finally, women's marital status is significantly and positively associated with the expected number of children according to the negative binomial estimates. This means women in this status have a higher expected number of children in relation to women who are never in a union. This result is expected as it is believed that married/cohabitation women may have a higher chance of conceiving compared to the reference group status (never in a union).

Based on the foregoing, I believed the government still needs to come up with more and strong policies regarding women empowerment especially women enrollments in secondary and tertiary levels of education in order to help lower the fertility rate of women as indicated in my result. Government policies on child marriage should be implemented accordingly to reduce teenage pregnancy. More sensitization programs should be done on sexual and reproductive health for youth especially in the rural areas where teenage pregnancy is more common. Women should also be thought about how to use modern contraception since our result indicates a positive correlation may be due to a knowledge gap during its usage. I believed further research can be done in this study if the GDHS can be conducted in different years in other to use Panel data which I believed may also have more variations. This will as well help in providing further evidence as to whether education has an impact on the total fertility rate.

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APPENDIX

Table 7: Statistical Summary

	SUM	MEAN	SD	VAR	MED
No education	26408.00	5.73	(2.34)	5.46	6.00
Primary	3722.00	4.99	(2.46)	6.08	5.00
Secondary	2515.00	3.47	(1.83)	3.36	3.00
Higher	458.00	3.32	(1.60)	2.57	3.00
Region					
Banjul	**1324.00**	**3.87**	**(1.70)**	**2.90**	**4.00**
Kanifing	3149.00	4.64	(2.13)	4.55	5.00
Brikama	**6483.00**	**5.16**	**(2.33)**	**5.43**	**5.00**
Mansakonko	2213.00	6.16	(2.76)	7.61	6.00
Kerewan	**5435.00**	**5.75**	**(2.57)**	**6.61**	**6.00**
Kuntaur	4668.00	6.02	(2.54)	6.46	6.00
Janjanbureh	**3539.00**	**5.59**	**(2.35)**	**5.52**	**6.00**
Basse	6292.00	5.13	(2.22)	4.93	5.00
Area of Residence					
Urban	9869.00	4.57	(2.15)	4.61	4.00
Rural	23234.00	5.73	(2.46)	6.04	6.00

Table 7 shows the mean, standard deviation variance, and median of the number of children per woman (fertility rate) of the total sum of women interviewed on different educational levels, region, and area of residence.

Table 8: Statistical summary on contraceptives

No method	SUM MEAN (SD) VAR MEDIAN = 30786.00	5.37	(2.43)	5.93	5.00
Folkloric method	SUM MEAN (SD) VAR MEDIAN = 31.00	3.44	(1.88)	3.53	5.00
Traditional method	SUM MEAN (SD) VAR MEDIAN = 72.00	3.60	(0.99)	0.99	3.00
Modern method	SUM MEAN (SD) VAR MEDIAN = 2214.00	4.86	(2.17)	4.73	5.00

Table 8 indicates the sum, mean, standard deviation, variance, and median of the number of children per woman of the total sum of women interviewed on different forms of contraceptive use.

Table 9: Statistical summary on the financial status

Poorest	SUM MEAN (SD) VAR MEDIAN = 7727.00	5.64	(2.28)	5.20	6.00
Poorer	SUM MEAN (SD) VAR MEDIAN = 8703.00	5.90	(2.62)	6.87	6.00
Middle	SUM MEAN (SD) VAR MEDIAN = 7918.00	5.51	(2.39)	5.71	5.00
Richer	SUM MEAN (SD) VAR MEDIAN = 5325.00	4.86	(2.34)	5.45	5.00
Richest	SUM MEAN (SD) VAR MEDIAN = 3430.00	4.08	(1.81)	3.29	4.00

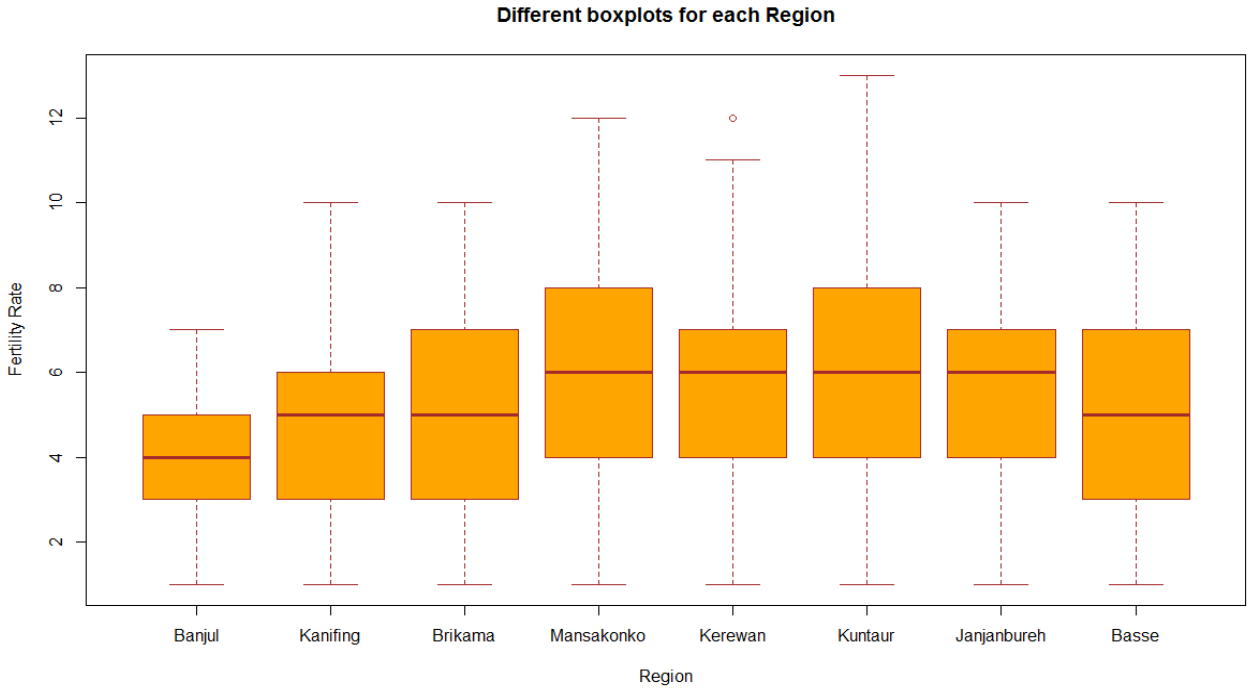
Table 9 shows the sum, mean, standard deviation variance, and median of the number of kids per woman of the total sum of women interviewed on their financial status.

Table 10: Statistical summary of count variables on age, education, and wealth

label	levels	Higher	No education	Primary	Secondary	p
Age	Mean (SD)	46.6 (13.6)	49.2 (15.6)	50.7 (16.0)	48.9 (15.3)	0.018
v025 (area of resident)	Urban	132 (6.1)	1248 (57.8)	267 (12.4)	514 (23.8)	<0.001
	Rural	6 (0.1)	3360 (82.8)	479 (11.8)	211 (5.2)	
v201 (fertility rate)	Mean (SD)	3.3 (1.6)	5.7 (2.3)	5.0 (2.5)	3.5 (1.8)	<0.001

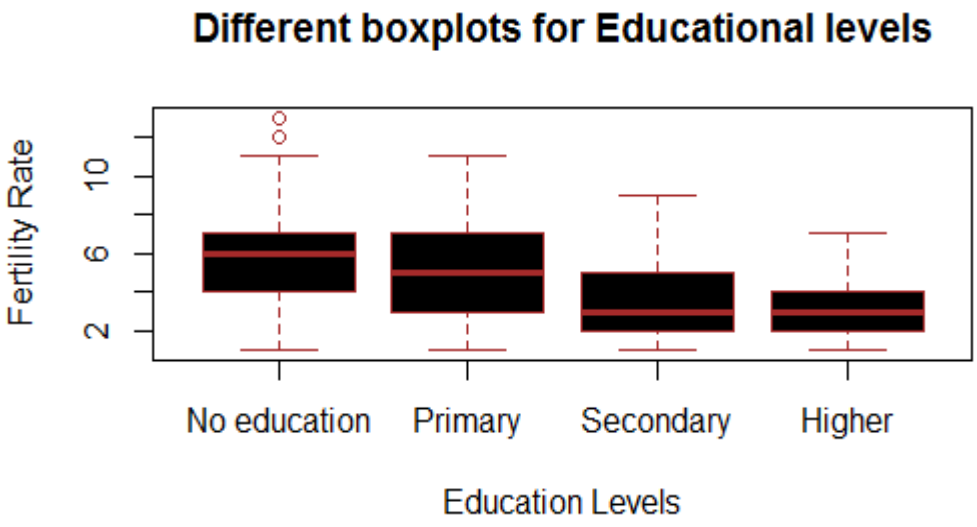
v191 (wealth index)	Mean (SD)	111492.9 (81787.0)	-26416.5 (67060.0)	-12863.7 (76608.6)	54571.8 (95592.0)	<0.001

Figure 8: boxplots for each region



Source: Author's construct from the study data

Figure 9: Boxplots for educational levels



Source: Author's construct from the study data

Figure 10: Pyramid

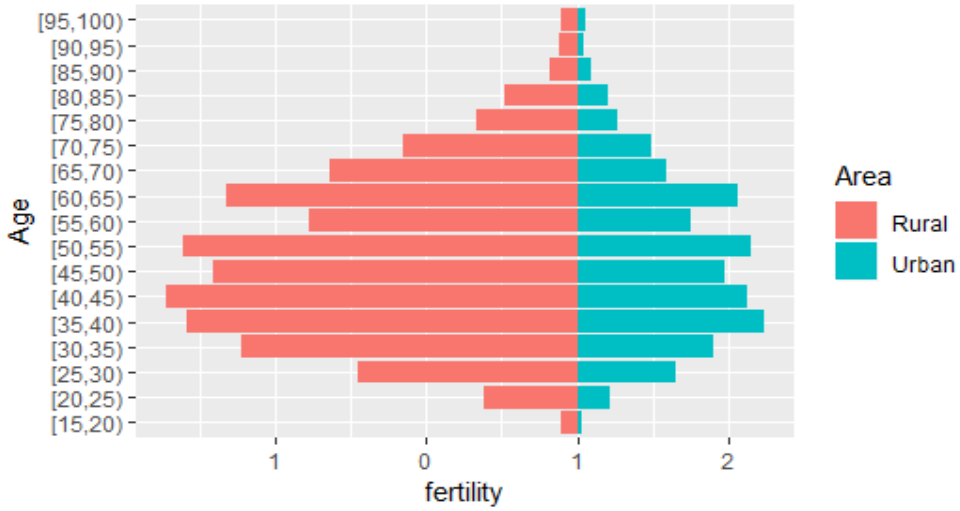
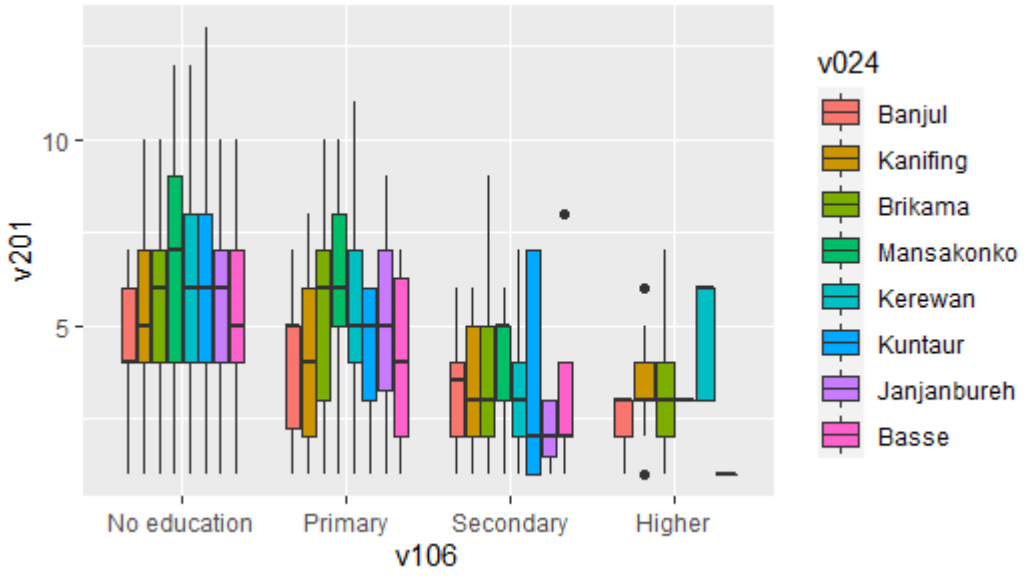


Figure 10 demonstrates a pyramid of fertility differentials of an area of residence (urban and rural) a gainst age.

Source: Author's construct from the study data



Source: Author's construct from the study data

Percentage of women, aged 20-24, who were married before age 18 or 15

	Married before age 18	Married before age 15
Gambia	30.0%	9.0%
Rural	45.9%	15.6%
Urban	19.7%	4.9%
No education	55.0%	18.2%
Primary education	47.2%	11.7%
Secondary education	14.9%	4.1%

Source: https://www.unfpa.org/data/adolescent-youth/GM

Percentage of women, aged 20-24, who gave birth before age 18 or 15

	Gave birth before age 18	Gave birth before age 15
Gambia	19.4%	4.1%
Rural	27.8%	6.3%
Urban	13.7%	2.6%
No education	34.7%	9.1%
Primary education	27.2%	3.3%
Secondary education	10.6%	1.5%

Source: https://www.unfpa.org/data/adolescent-youth/GM

Percentage of girls, aged 15-19, who are in a marriage/union and are currently using any method of contraception

	Not currently using	Currently using any method	Currently using any modern method
Gambia	96.7%	3.3%	2.2%
Rural	98.2%	1.8%	1.2%
Urban	94.1%	5.9%	4.0%
No education	98.5%	1.5%	1.2%
Primary education	99.5%	0.5%	0.5%
Secondary education	89.4%	10.6%	6.3%

Source: https://www.unfpa.org/data/adolescent-youth/GM