UNIVERSITY OF GHANA

THE ROLES OF EDUCATION, CONTRACEPTION AND DESIRED FERTILITY ON LIBERIA'S FERTILITY

BY

OPPONG AMOO-GAISIE

(10372548)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY IN ECONOMICS

JUNE 2018

DECLARATION

I do hereby declare that this thesis is the result of my own original research and has not been presented by anyone for any academic award in this or any other university. All references used in the work have been fully acknowledged and I am responsible for all errors and omissions within the work.

....

OPPONG AMOO-GAISIE DATE

(10372548)

CERTIFICATION

I hereby certified that this thesis was supervised in accordance with the laid down procedures of the University of Ghana.

....

DR. NKECHI S. OWOO DATE

(PRINCIPAL SUPERVISOR)

....

DR. BERNARDIN SENADZA DATE

(CO-SUPERVISOR)

ABSTRACT

After about a decade of civil war, Liberia still has a fertility similar to other countries who have not had such similar experiences. The civil war was expected to lead to a decrease in fertility given the expected increased usage of contraceptives and decrease in the desire for children. So, the question about the role of education, contraception and desired fertility was asked. To answer this question, four main questions were asked. First, whose education is more significant in reducing fertility, husband or wife? Second, does usage of contraceptive lead to low fertility? Also, does the desire for more children or another child lead to having higher fertility? Lastly, does the woman's education (wife's) have only a direct effect, only an indirect effect or both direct and indirect effects? Unfortunately, there was no available data that was collected during or a few years after the civil war. Trends for Liberia from the 1970s to the 2010s have shown that education and contraceptive usage shows an upward trajectory while the average ideal number of children (proxy for desired fertility) shows a downward trajectory.

Using three waves of the Liberia Demographic and Health Survey data along with a Poisson regression analysis and the Structural Equation Model, this study found; First, for 1986 wave, husband's education, rather than wife's education, was more significant in explaining fertility. In the 2007 wave however, wife's education, rather than husband's education, was more significant in explaining her own fertility. In the 2013 wave, both wife's education and husband's education were found to be significant in explaining fertility. Secondly, usage of modern contraceptives has a significant positive effect on fertility for the three waves while usage of traditional methods had significant positive effect on fertility for only in 2013. This finding is consistent with empirical works that have found pacing of birth to be the reason for increase demand for contraceptives. Overall, contraception, like wife's education, was significant in explaining fertility in Liberia. Also, desired fertility had a

significant positive effect on fertility. While education, especially wife's education, has contributed to the fertility reduction in Liberia, contraceptive usage and desired fertility have played no role in Liberia's fertility reduction. Age of a woman, age at first birth, child deaths and urban residence have also contributed in explaining fertility differential in Liberia. Lastly, wife's education has both direct and indirect effects on fertility, which means the effect of wife's education on fertility is partially mediated by contraception and desired fertility. Whereas in 1986 the indirect effect is positive, in 2007 and 2013 the indirect effect is negative.

DEDICATION

I dedicate this study to the Almighty God, my parents, siblings, maternal uncles, friends and all who have one way or the other contributed, directly or indirectly, to where I have gotten to in life.

ACKNOWLEDGEMENTS

I am very grateful to the almighty God under whose guidance and protection I was able to complete this work. Also, a special thanks to my parents, siblings, maternal uncles (especially Mr. Felix Agyenim Boateng), friends and colleagues for their support, care and concern. Again, an earnest thanks to my supervisors for their guidance through comments and suggestions for making this work a success. Lastly to the DHS Program for the granting me access to the data used in this study.

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LIST OF ABBREVIATION

SSA	Sub-Sahara Africa
DHS	Demographic and Health Survey
LDHS	Liberia Demographic and Health Survey
GDHS	Ghana Demographic and Health Survey
SDHS	Senegal Demographic and Health Survey
NDHS	Niger Demographic and Health Survey
FPAL	Family Planning Association of Liberia
SEM	Structural Equation Model
GSEM	Generalized Structural Equation Model
PCA	Principal Component Analysis
CEB	Children Ever Born

CHAPTER ONE

INTRODUCTION

Fertility levels have declined across the globe, but Africa's fertility is still above its replacement. Beginning the first phase of the demographic transition in the early 1950s, Sub-Saharan Africa experienced high population growth rate due to high birth rate, but began to experience decreasing fertility in the next phase of the transition in the 1980s (Owoo et al., 2015). This declining fertility according to some scholars was led by crisis which was either economic or political in nature (Agadjanian & Prata, 2002; DeRose et al., 2002; Eloundou-Enyegue et al., 2000). Decades of high fertility (compared to other regions like North America, Europe among others) complemented by increasing survival of children in most developing countries, including Sub-Saharan Africa (SSA) has led to increasing dependency burden through an increase in young population, making economic growth and development agendas through human capital investment a daunting task (Ashford, 1990; Kollehlon, 1989; Shapiro, 2017).

Africa's youthful population is expected to increase by 40% in 2030, doubling in 2055 from its current level and at same time continue its growth trajectory for the remaining part of this century (Population Devision, 2015). With this, Africa cannot realize much improvement in standards of living of its people (World Bank, 1989). The high demographic pressure resulting from increasing population with a fertility rate of about five children has led to unemployment especially for the youth, food insecurity and pressure on basic social service like education, health, water, electricity among others in the sub-region (Economic Community of West African States, 2012). With the relatively higher youthful population and current fertility rates way above the replacement rate, SSA still needs to control its population (Williams, 2012; Youthpolicy.org, 2010).

Increase usage of contraceptive, higher level education and a decrease in desired fertility have greater potentials of reducing fertility. For instance, according to de Bruijn (2006), research has shown that contraceptive practice is among the five-strong proximate factors in determining the level and differentials of fertility. Also, according to Pritchett (1994), a greater portion of the fertility differential can be explained by desired fertility. Whereas a report by The Africa-America Institute (2015) has shown that there has been an increase in both primary and secondary education across Africa, research by Sharan et al. (2009) and Tsui et al. (2017) have shown that, Africa has since 1995 experienced an increase in the usage of modern contraceptives and for that matter contraceptive usage.

Again, with an increase in the participation of women in the labour market complemented with increased earning opportunities available for women, desired fertility, as measured by the ideal number of children, is expected to decrease (Bhattacharya & Haldar, 2012; Kreyenfeld, 2010; Ortiz-Ospina & Tzvetkova, 2017; Snopkowski et al, 2016; Verick, 2014). Yet the space at which population is declining in SSA is quite alarming. Research has shown that, for a substantial decline in fertility to occur in the region, a significant drop in fertility desires are required (Beatty, 2015). According to Bongaarts (2008), if Sub-Saharan Africa (SSA) continue with its recent slow pace of fertility transition, the size of SSA's population may reach 2.02 billion in 2050. According to him, this will have an adverse effect on the economies of SSA in terms of development, food security and resource sustainability.

Knowledge about education-fertility, desired fertility-actual fertility and contraception-fertility relationships will inform policymaker on how to design and implement fertility driven educational policies; on the extent to which family size ideals should be lowered to achieve the desired drop in actual fertility; on the role of contraceptives in reducing fertility. Also, it will inform policymakers about the unmet need for contraception and how best to implement family planning programs.

1.1. Statement of Problem

Although Sub-Saharan Africa (SSA) is perceived as a possible source of population threat in the future, a number of countries such as Liberia and Sierra Leone among others have received little attention as far as fertility studies are concerned. Whenever issues of population are raised in Africa, large population countries like Nigeria, the Democratic Republic of Congo among others receive the greatest attention. Small-population but high-fertility countries like Liberia, Sierra Leone, Togo, Guinea Bissau, Republic of Congo among others receive little or no attention. Also, among the sub-regions in SSA, the west has always been among the sub-regions with relatively high fertility (Bongaarts & Casterline, 2012; Bongaarts et al., 1984). Against this backdrop, this research seeks to inquire about the role of some variables in Liberia's fertility, a country located on the west coast of Sub-Sahara Africa (SSA). The population of Liberia has more than doubled within 33 years, with more than 60% of its population under age 25. Existing work on Liberia has focused more on cultural, religious and proximate determinants of fertility (Kollehlon, 1989, 1994; Nichols et al., 1987), with Kollehlon (1984) inquiring into the employment status and occupation of women and their fertility behaviour.

Although Liberia has a relatively small population and has experienced fertility decline since 1981, it continues to have an average fertility rate of 4.6 children per woman with a population growth rate of 2.44%. The estimated population is measured at approximately 4,689,021, which represents a little more than a 100% increase from its 1984 population (2.3million). With more than a decade of civil war experience (between 1989-2003) fertility rates should be considerably low, with a signification portion of any increase coming from the younger cohorts, since they have experienced little or no crisis (DeRose et al., 2002; Eloundou-Enyegue et al., 2000). War and its resultant economic downturn are expected to

have a negative effect on fertility through delayed marriage, increased incidence and duration of marital separation, lower frequency of intercourse and impaired fecundity and gestation as well as the discouragement resulting from uncertainties. These will in turn force the affected individuals to postpone birth or delay entrance into the next party by using contraceptives even if the affected people have a high taste for shorter birth interval and larger family size. (Agadjanian & Prata, 2002; DeRose et al., 2002; Eloundou-Enyegue et al., 2000). Fertility decline during and some few years after the war is similar to that of other countries in SSA like Ghana, Zambia and Madagascar who had not gone through such crises.

Furthermore, with an increase in education, the value of time increases and is expected to cause a decrease in fertility (Diebolt & Doliger, 2005). Increase in the value of time should cause childbearing age couples (or women) to desire fewer children. Also, if because of education, the cost of having another child outweighs the cost of controlling birth, then more contraceptives will be demanded. Educational enrollment for the most part of the war period saw a gross increase from 36.40%, 9.36% and 0.93% in 1970 to 102.38%, 45.16% and 9.30% in 2011 respectively for primary, secondary and tertiary educations; contraceptive usage saw an increase as well (Liberia Data Portal, 2016; LDHS Report, 2008, 2014). Desired fertility (as measured by the average ideal number of children) saw only a slight decrease from about an average of 5 children per woman in 2007 to an average of 4.8 children per woman in 2013. Increase in educational enrollment and contraceptive usage, coupled with decreasing fertility desires is expected to cause a significant decrease in the fertility of Liberian women.

Although there is no information to investigate the effect of the civil unrest on fertility, what role did education and contraception play in the fertility changes observed in Liberia? Has the level of education, necessary for a drop-in fertility, increased over time? What was the

reason the increasing contraceptive demand? Better still, is the decreasing effect of desired fertility so small to complement the decreasing effect of the civil war, education and contraceptives usage have on fertility? Therefore, the question about the role of contraceptive, education (of both women and men) and desired fertility in determining fertility may shed more light on this puzzling situation in Liberia.

Also, the question about the mechanisms through which education affects fertility has not been answered for most countries, so in trying to know more about the roles of education, contraception and desired fertility, inquiring about whether education's effect on fertility is fully mediated by contraception and desired fertility will contribute to the fertility literature. This analysis of mediation will give a more in-depth knowledge on the mechanisms through which education affect women's fertility in SSA.

1.2. Justification for Mediators

Mediation is where the effect of an independent variable on a dependent variable passes through a chain of effect(s), thus, the independent variable (the causal variable) affect some variable(s) called the intermediate, intervening or process variable(s), which in turn affect the dependent variable also called the outcome variable. The mediating variable accounts for the relationship (thus, the why and how) between the independent variable and dependent variable. The need for mediation test is to broaden our understanding of the processes through which one variable affects another variable (Namazi & Namazi, 2016). For instance, education is known to affect fertility negatively, how does this effect takes place? First of all, education increases the productivity of a person which in turn increases his/her chance of gaining employment in a better-paying company or working environment. Consequently, employment in a higher paying job will increase the income/wealth of the individual and for that matter his/her household. This will intern cause the individual to

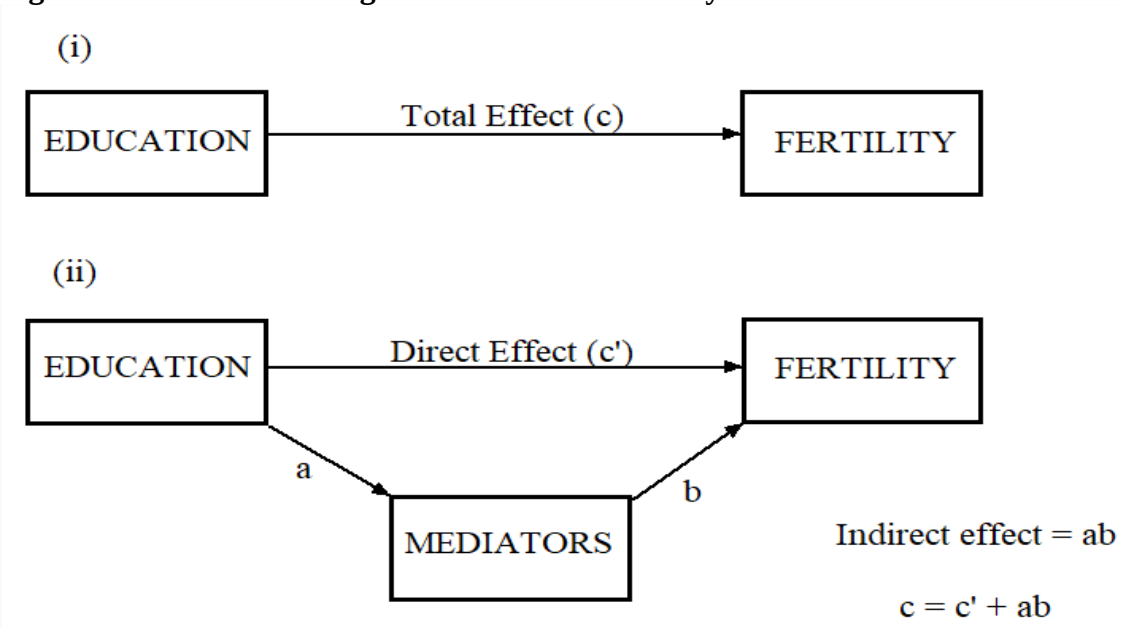
demand more quality children over quantity. (Becker & Lewis, 1973; as cited in Ahene-Codjoe, 2007). This implies that, education leads to the employment of a person, which in turn leads to the increase in the income or wealth of his/her household and then eventually leads to a decrease in fertility. Also, highly educated women can take good care of their children by providing them with better nutritional diet and health care, which then increases the survival rate of their children. A woman of such calibre would be certain of achieving her desired fertility. Thus, the education of women, decrease the mortality rate of her children which in turn decrease her fertility. In these two examples, education is the independent or causal variable, employment, decreased child mortality and increased household income are the mediating variables and fertility is the dependent or outcome variable.

Education, especially women's education, is known to decrease own child mortality, increase knowledge and use of contraceptive and increase the socio-economic status of a woman among other variables. All these factors also affect fertility (Jejeebhoy, 1995; Snopkowski et al., 2016). As to whether these mediating variables fully or partly mediate the effect of education on fertility remain unanswered in most countries and is part of the objectives of this research to determine whether contraceptive usage and the fertility desire of a woman mediate the effect of education on fertility in Liberia. For instance, Tawiah (2017) pointed out a possible relationship between education and contraceptive usage, living conditions and age at marriage in a study he carried out in Ghana, whereas a paper by Snopkowski et al. (2016) estimated the relationship between women's education and working status, local mortality, husband education, social class and contraceptive use. In the three sites (locations) selected by the authors, the estimation produced the expected relationships between education and the five mediating variables, but the relationship between these variables and fertility is where the difference lies. Most of these mediating

variables were mediated by another set of variables. In a nutshell, while some yielded the expected relations in two or all the sites, others showed no relationship between them and fertility.

In Liberia, while one research talked about a break in the link between education and employment (Kollehlon, 1984), other empirical works have shown that education increases the use of contraceptive in Liberia (Nichols et al., 1987; Nicholas, 1995). Since, enough work has not been done on fertility and other variables, it is difficult to conclude without any evidence about variables that will mediate the effect of education on fertility and so using data from Liberian Demographic and Health Survey (LDHS), more can be said about the variable that mediates the effect of education on fertility.

Figure 1.1: Illustrative diagrams for mediation analysis



Adopted from (Fritz & Mackinnon, 2008) modified by Author

1.3. Research Questions

This research seeks to answer the following questions;

I. Whose education is more important in influencing fertility, husband's education or wife's education?

II. Has contraceptive usage been an important contributor to the observed reduction in fertility in Liberia?

III. What is the effect of desired fertility on the actual fertility (number of children ever born)?

IV. Do contraceptive usage, contraceptive knowledge and desired fertility mediate the effect of education on fertility?

1.4. Objectives of the Study

The objective of the study is to determine;

I. The relative contribution of husband's and wife's education to fertility decline in Liberia.

II. The effect of contraceptive usage on fertility.

III. Whether fertility preference significantly is a determinant of fertility variations among Liberian women.

IV. Whether the effect of women's education on fertility is mediated by contraception and desired fertility.

1.5. Significance of the study

Although education is generally accepted to have a negative effect on fertility, empirical findings on the relative effects and significance of wife's education and husband's education

are mixed. This study will help determine the relative importance of wife's and husband's education in reducing fertility. Also, given the limited and dated empirical works undertaken on fertility in Liberia, this study, contributes to the literature by providing more recent knowledge on the roles of contraception and desired fertility in the declining fertility in Liberia. Further, the relative significance and effect of husband's and wife's education on fertility may have changed over time, this study employs three waves (1986, 2007 and 2013) of the LDHS data to inquire about changes in the effect and significance of education, contraception and desired fertility on fertility. In terms of the mediation analysis, the structural equation model (SEM) is used in determining whether the effect of wife's education on fertility is fully, or only partially, mediated. The mediation analysis will contribute to the literature on the mechanisms through which education affects fertility in Liberia.

1.6. Organization of the Study

This study is organized into six chapters. The first chapter begins with a brief introduction, statement of the problem, the justification for a mediation analysis, objectives of the study, research questions and significance of the study. Chapter two provides an overview of Liberia and brief information on fertility, education, contraception and desired fertility in Liberia. The third chapter reviews some literature based closely on the objectives of the study. Chapter four is the methodology which includes the source of data, econometric analysis employed in the study. The next chapter presents the analysis and discussion of the result, it involves a count data analysis and a structural equation analysis (SEM). The last chapter concludes with a summary of key findings and recommendations.

CHAPTER TWO

OVERVIEW

Bounded by Sierra Leone to the west, Guinea to the north, Cote D'Ivoire to the east and the Atlantic Ocean to the south, Liberia is divided into fifteen political regions called counties and is diverse in terms of religion and ethnicity. The population of Christians and Moslems is about 98% of the country's population, although Christians alone are a little more than 85% of the entire country's population. Liberia has an infant mortality rate of 65.8 deaths/1000 for the entire population while that of male and female infant mortality is 69.9% and 61.5% respectively. (Central Intelligence Agency (CIA), 2017). Literacy rate remains relatively low at 47.6% for the entire population, 62.4% for males and 32.8% for females, thus a huge educational inequality gap between males and females. This is not uncommon for most SSA countries (USAID, 2013; World Health Organization, n.d.).

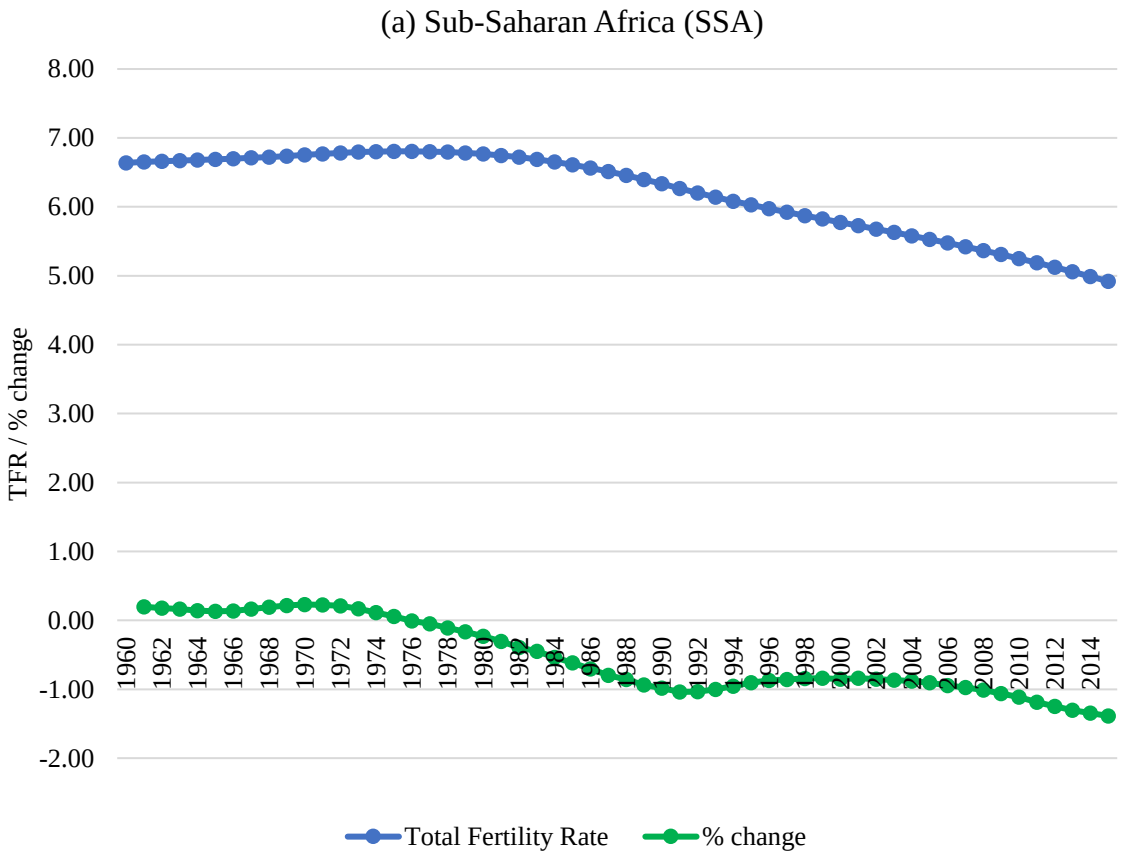
2.1. Trends in Liberia

Fertility (TFR) in Liberia has been falling inconsistently since 1981. Educational levels and literacy rates have increased for both males and females. Female secondary education, for instance, has increased from 23.02% in 1970 to 43.00% in 2014 (Liberia Data Portal, 2016). Also, contraceptive usage (usage of any method) has increased from 6.4% (for 1986LDHS) of women between 15-49 years to 20.2% (for 2013LDHS) of women between 15-49 years, with the main source of increase being an increase in the usage of modern contraceptives. Desired fertility has decreased, but the decrease is relatively less than the decrease in actual fertility.

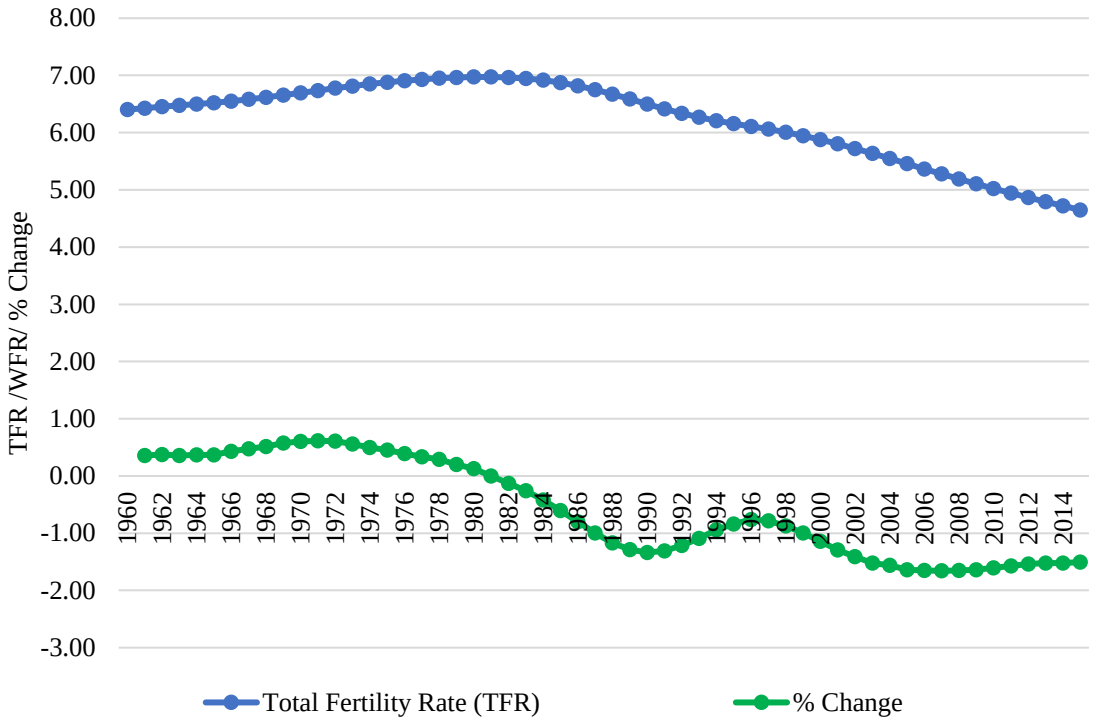
2.1.1. Fertility

Total fertility rate (TFR) has been decreasing for both SSA and Liberia since 1975 and 1981 respectively as indicated in Figure 2.1, but SSA has experienced a gentle fall in TFR after reaching its peak in 1975. From chart (b), Liberia reached its peak in terms fertility in the year 1981 and has since then experienced a relatively greater decline in its TFR, compared to the whole of SSA presented in graph (a). The gentle and slow change in SSA's fertility, as indicated by the green curve in chart (a), since the mid-1990s corroborate with the stalling fertility some scholars believe to have taken place in their country and SSA at large (Agyei-Mensah & Owoo, 2015; Bongaarts, 2008; DeSouza et al, 2014; Owoo et al., 2015) .

Figure 2.1: Total Fertility Rate (TFR) [Births per Woman] and Percentage Change in TFR for Sub-Sahara Africa and Liberia from 1960 to 2015



(b) Liberia



Data Source: (World Bank, 2018)

Though Liberia has experienced a fall in fertility since 1981, this fall has been inconsistent as indicated by the green curve in chart (b). There has been a decrease at a relatively faster rate in the 90s and a relatively slower rate in the early 2000s, but from the green curve in (b), fertility in Liberia has been falling at almost a constant rate since 2004.

2.1.2. Education

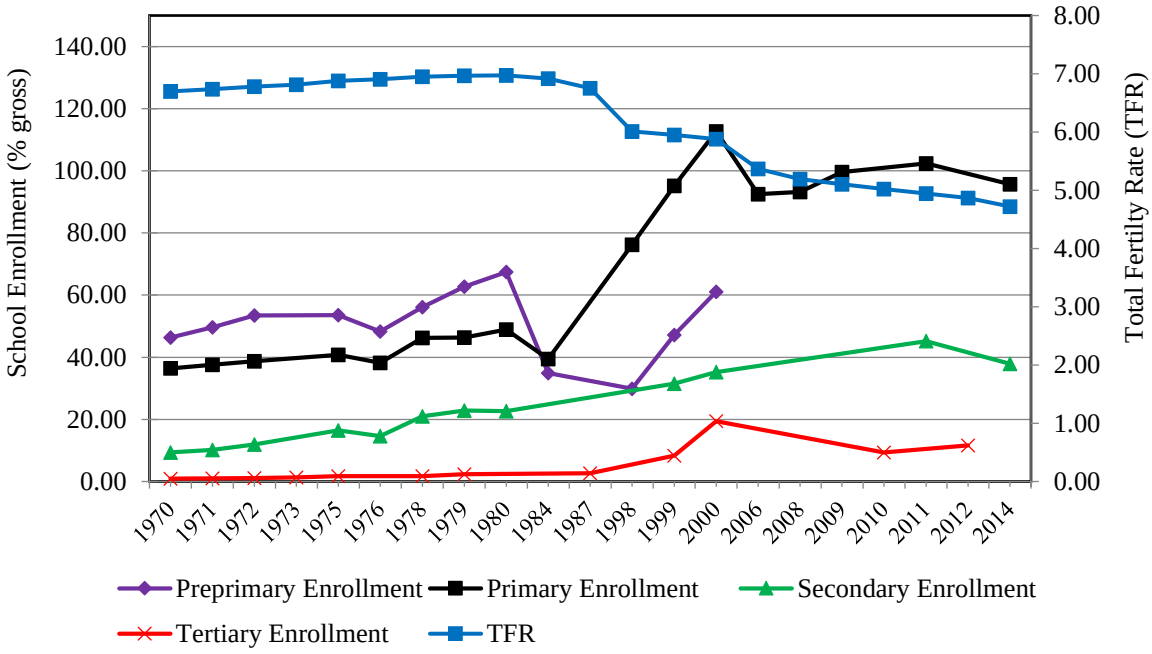
Education through its various influence on our lives (increase in knowledge base, autonomy, labour market opportunities, attitudes and perception), shape both the reproductive and productive role of people, especially for women, which in turn affect their fertility (Rindfuss et al., 1980; Shapiro, 2017; Weinberger, 1987). The educational differential in fertility is expected to be wide in the early stages or during fertility transition of a country, but prior to

fertility transition and the latter part of the transition, only a smaller gap is expected (Martin, 1995; Weinberger, 1987).

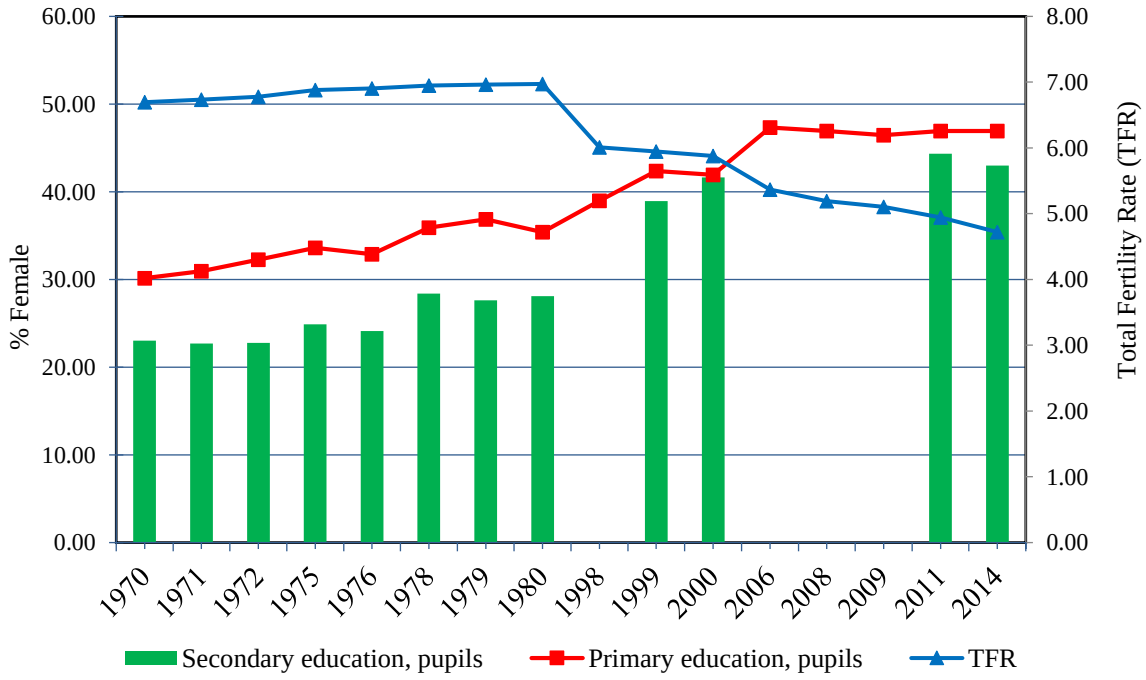
From Figure 2.2, except for pre-primary school enrollment that experienced a decrease in gross enrollment from 1980 to 1999, generally, all other levels of education have seen an increase in gross enrollment. Though there are some missing data, the available data as plotted in Figure 2.2 graph (a) indicates an increase in gross enrollment level for primary and secondary from 1970 up to 2011, with a slight decrease in the enrollment level for 2014. Tertiary enrollment until 2000 has been increasing, though not as fast as secondary enrollment. Also, tertiary enrollment began to experience a decrease in gross enrollment from 19.4% in 2000 to 9.3% in 2010 and per the 2012 value of 11.64% it indicates a slight increase from its 2010 value. The sharp increase in gross enrollment can be ascribed to the government's objective of making universal basic education an explicit development objective and expansion of access to education by various governments as well as the enforcement of the article 6 of the Liberian constitution in 1986 (International Institute for Educational Planning, 2011; Ministry of Education, 1984; UNESCO-IBE, 2010). The slight drop in 2014 is due to increased school fees by the public school (Darvas & Namit, 2016). According to Darvas & Namit (2016), there has been a great increase in enrollment after the Ebola pandemic and according to them is due to the active media campaign by the Education Ministry to encourage children of school going age to go back to the classroom and support from some international organizations like the World Bank. Also, the graph (b) in Figure 2.2 shows an increase in enrollment for females in both primary and secondary level since 1970 with a slight drop in 2014. As shown by the blue line in each graph, fertility since mid-1980s has been falling.

Figure 2.2: Education Enrollment in Liberia

(a) School enrollment



(b) Female Education



Source: (Liberia Data Portal, 2016; World Bank, 2018)

Literacy rate has increased substantially from 34% of men and 17% of women in 1986 to 71% of men and 48% of women in 2013, according to the DHS reports, but the literacy inequality gap between men and women has only reduced slightly.

Furthermore, due to the disconnection in the link between education (qualification) and employment in Liberia (Kollehlon, 1984), employment and labour force participation rate for both the entire population and females have increased only slightly from 1990 to 2016. Female labour force participation rate has increased from 56.26% in 1991 to 57.94% in 2016, whereas female employment to the population of women 15 years and above has increased from 54.06% in 1991 to 55.64% in 2016 (World Bank, 2018).

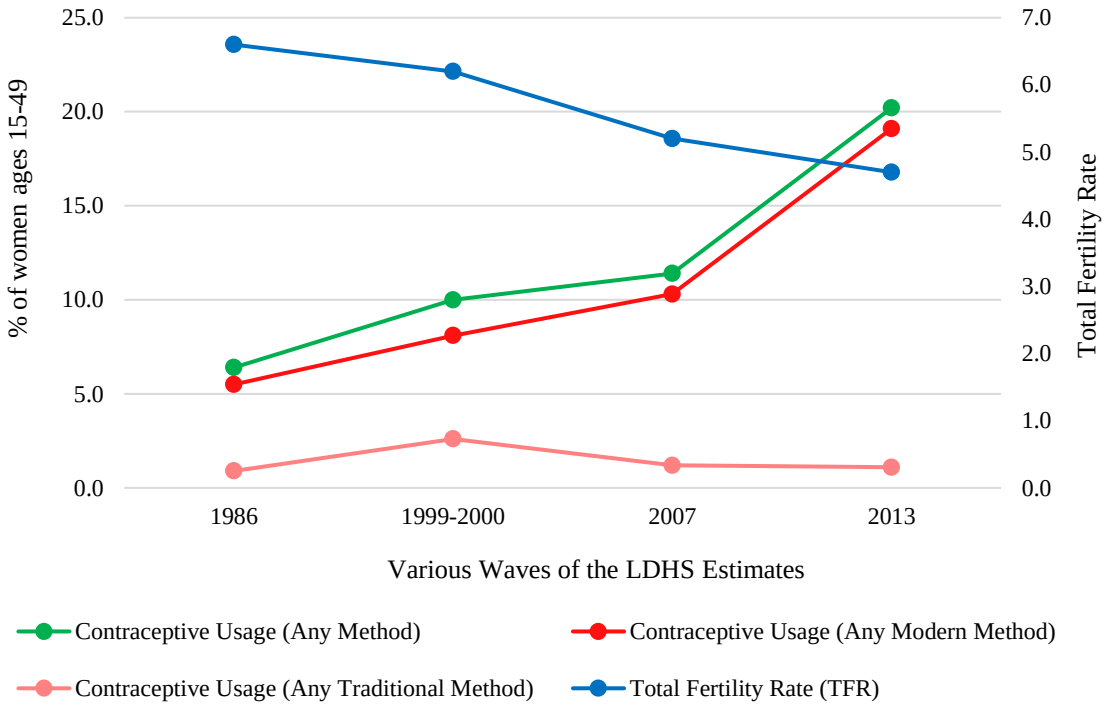
2.1.3. Contraceptive

Information on contraceptive prevalence is scanty, but the available data as shown in Figure 2.3 from the various waves of the Liberia Demographic and Health Survey (LDHS) reports, indicate a continuous increase in contraceptive prevalence from 6.4% in 1986 to about 20% in 2013 for all kinds of contraceptives.

The prevalence of modern contraceptive has also increased from 5.5% in 1986 to about 19% in 2013, but the rate of increase has not been consistent. The use of any traditional contraceptive, as indicated by the light red curve in Figure 2.3, increased between 1986 and 1999-2000, but has been decreasing since 1999-2000, though the decrease in 2013 was less relative to that of 2007. Total fertility, represented by the blue curve in Figure 2.3, have been decreasing consistently from 1984 to 2012. Also, data from the World Bank's World Development Indicators (2018) shows the use of condoms by adolescents has increased for both males and females, from 18.6% and 9.2% in 2007 to 39.3% and 15.9% 2013

respectively. Among contraceptive users, a greater proportion has used at least one modern method of contraceptive.

Figure 2.3: Contraceptive Usage and TFR



Data Source: (LDHS Report, 2008, 2014)

2.1.4. Fertility Desire

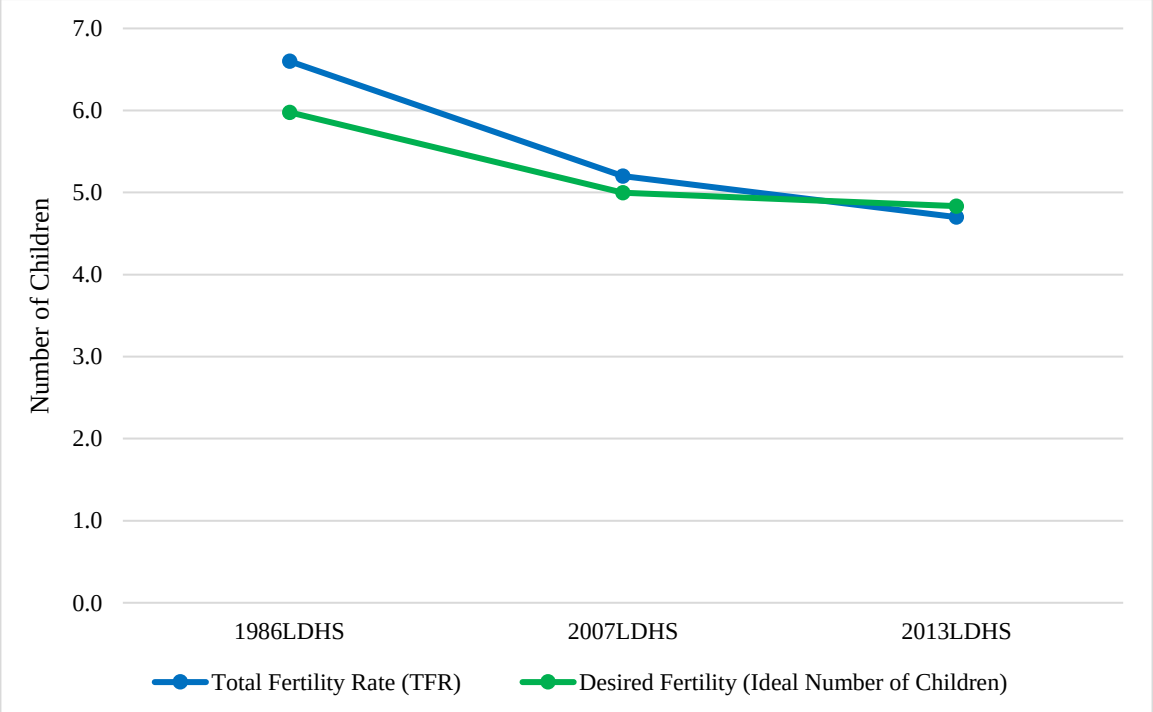
Information on desired fertility is very important to family planning program, since it allows for the determination of an unmet need for contraception (Kodzi et al., 2010), but it is also believed that the number of children parents have is influenced by the number they desire or prefer (Schultz, 1969).

Figure 2.5 is a graphical presentation of desired fertility and actual fertility for 1986LDHS, 2007LDHS and 2013LDHS. The green curve and the blue curve represent desired fertility and actual fertility respectively. Also, desired fertility is measured as the average ideal number of children while actual fertility is measured as the average number of children ever born (CEB). From the Figure, both desired fertility and actual fertility has decreased, but

actual fertility has decreased more than desired fertility. Whereas in 1986 and 2007, desired fertility was less than actual fertility, in 2013, actual fertility was less than desired fertility. The difference in 1987 may be due to the fact that only the educated few had the knowledge and accepted the use of contraceptives whereas the majority who are not educated had little or no contraceptive knowledge, hence does not use contraceptives. This, therefore, makes the achievement of fertility desire somewhat an impossible event. The significant increase in the usage of modern contraceptive between 2007 and 2013 (see Figure 2.3) is an evidence of increasing contraceptive knowledge leading to increase contraceptive usage, giving women the opportunity to achieve their fertility targets.

Again, the difference between desired fertility and actual fertility is smaller for 2007 and 2013 compared to the difference in 1986.

Figure 2.4: Desired and Actual Fertility



Data Source: (LDHS Data 1986, 2007, 2013)

CHAPTER THREE

LITERATURE REVIEW

Fertility is an interdisciplinary topic which is of interest to economists, sociologists, psychologists, demographers, anthropologists among others alike. Fertility is not a recent phenomenon and has been approached from different angles. Whereas some scholars have studied fertility from a temporal perspective (Mari Bhat, 2002; Murthi, 2002), others have studied it from a spatial perspective (Agyei-Mensah & Owoo, 2015; Benefo & Schultz, 1996; Owoo et al., 2015), yet others have looked at it from a spatio-temporal perspective (Kodzi et al., 2010; Kreyenfeld, 2010; Musick et al., 2009).

A common belief is that one factor cannot account for all the differences and variations in fertility behaviour or preference. This chapter reviews various works on fertility and is in two main sections. The first section reviews some theories of fertility decline while the second section review some empirics and is organized in relation to the objectives of the study. The section that follow review empirical works of others in relation to the effect of education, contraception and desired fertility on fertility. This section also does a brief review on other variables that affect fertility, which are employed as control variables in the analysis. The last section gives a brief review of mediating effect in general and the mediation effect of education's effect on fertility.

3.1. Theory

Prior to Leibenstein's exposition in 1957, explanation of fertility behaviour was based on the demographic transition model. The demographic transition is simply the shift from high to low fertility and mortality associated with the process of modernization (Easterlin, 1983) or "the process by which fertility rates eventually decline to replacement levels" (Todaro &

Smith, 2011; pp 278). The model explains why the three-stage population history is to a larger extent a common characteristic of the present-day developed countries. Thus it explains "the transition from stable or slow-growing populations first to rapidly increasing numbers and then to declining rates" as a common characteristic of the present-day developed countries (Todaro & Smith, 2011; pp 278). The stage one preceded an economic modernization and is characterised by a very slow-growing population, resulting from a high birth rate and an almost equally high death rate. In stage two, the genesis of economic modernization, there is a reduction in mortality which leads to an increased life expectancy but unaccompanied by an immediate decline in fertility. In stage three, the forces of modernization initiate a fertility decline, which eventually converges with lower death rates and leads to little or no population growth (Todaro & Smith, 2011). The third stage was particularly useful for explaining the declining or lower fertility of the then-advanced countries. The transition theory laid more emphasis on declining desired fertility which through some means translated into a fall in actual fertility. The transition theory was satisfactory for a number of demographers (which included some economists), but not so much for more theoretically-trained economists (Leibenstein, 1974). The introduction of utilities and disutilities by Leibenstein (1957) was intended to contribute to the third stage of the transition theory. Leibenstein's focus was to address why over time fertility decline generally as an economy becomes more advanced or why fertility is lower for higher income households (Leibenstein, 1974; Robinson, 1997).

Becker (1960), using the household production function (demand or household theory of fertility), tried to provide some sort of generalization to the economic theory of fertility behaviour (Sanderson, 1976). According to Becker (1960), children are assumed to provide utility. The utility derived from children is compared to the utility derived from other goods via the use of an indifference curve or a utility function. The shape of the indifference curve

according to Becker (1960) depends on taste (defined as the preference for children), which is determined by religion, race, age, and other variables. In his quality definition, he defined a high-quality child to be a child who receives relatively higher expenditure from his/her parent and with every additional expenditure, there is an additional utility to the parent.

> *Thus, an increase in income should increase both the quantity and quality of children, but the quantity elasticity should be small compared to the quality elasticity.* (Becker, 1960; pp 212)

With the assumptions of household behaviour being rational with unchanging tastes and commodity prices being fixed, Becker concluded that wealthy families will have a relatively larger number of children compared to families in relatively lower income bracket (Leibenstein, 1974; Robinson, 1997). An empirical test of Becker's conclusion (hypothesis) gave an opposite result (Leibenstein, 1974). Becker (1960) added that, a decrease in child mortality would lead to a decrease in birth. Also, knowledge about contraceptives has made birth control relatively easier, which has greatly reduced the psychic cost associated with birth. This will increase the quality of children while reducing the quantity of children.

Challenging Becker's formulation, Easterlin (1966) rejected the unchanging taste assumption (Sanderson, 1976). According to Easterlin (1966), fertility is expected to vary inversely with desired consumption level, given that income level is constant. Couple who have come from relatively high-income household have much taste for consumption goods. They would, therefore, spend much of their income on consumption goods. This then means that families who have previously experienced higher income would desire or have fewer children. In line with this, Easterlin (1966) found a slight increase in the income of young persons and a decline in the net worth of young cohorts. The young cohorts were coming from a wealthier background than their predecessors. This means the young cohorts will prefer fewer children than their predecessors.

Again, Becker & Lewis (1973) contributed to the debate on the relationship between income change and fertility behaviour by introducing the (shadow) price effect into the framework of fertility behaviour (Ahene-Codjoe, 2007; Sanderson, 1976). In their model, a clear distinction was made between the quality of children and quantity of children. Whereas the former dwelt on the amount of investment that has gone into the up bring of children, the later dwelt on the number of children. According to Becker's analysis, increase in income will increase the demand for children, but the extension of Becker & Lewis (1973), brings into the analysis increase in the shadow price of children as the demand for children increases. As the income of parents increases, they will increase spending on both their consumption and that of their children. Given this positive relationship between income and consumption, makes children more expensive to relatively high-income families. This explains why parents will prefer fewer children as their income increases. According to them, child quality is relatively more income elastic than child quantity. This implies that increase in income will lead parents to demand more quality than quantity of children (Diebolt & Doliger, 2005). The contributions of Becker & Lewis (1973) explained why relatively higher income families will want or give birth to fewer children.

The relaxation of the fixed price assumption in 1973 by Becker was directly opposite to Easterlin's relaxation of taste assumption. This led to a purely economic theory by Becker as against a mixture of economics theory and sociology by Easterlin. In all these, there was a common ground between Becker and Easterlin expositions of the theory of fertility. They both agreed that the income-fertility relationship could either be positive or negative; holding enough variables constant, renders the income-fertility relationship positive. Also, both Becker and Easterlin schools believed that when income changes, other variables are likely to change which would, in turn, have an offsetting effect on the income-fertility relationship. The main bone of contention between Becker and Easterlin schools of thought

was the nature of the offsetting and not the extent. Also, the paper by Becker & Tomes (1976) provided an intergenerational model for fertility analysis like that of Easterlin (1966), this levelled the major part of the grounds between the camps of Becker and Easterlin (Sanderson, 1976).

In addition, Leibenstein (1974) acknowledges the contributions of others in the areas of infant mortality effect, socioeconomic status, threshold values in income and/or education and change in norms and institutions. He went further to say;

> *"The determinants of fertility are many folds. Some causes of fertility changes are historically unique, others depend on socioeconomic and cultural variables. No single aspect offers a complete explanation. … Social and economic influences must not be considered in isolation. The basic notion is that economic changes influence the social status of families. As a consequence of the changed social status situation, tastes change not only for children, but simultaneously for a) goods that compete with children, and b) the goods and services involved in the nurture of children."* (Leibenstein, 1974; pp 471)

Fertility behaviour does not depend only on variations in economic conditions but also on social and cultural changes. So using economic theory alone would not give a clear picture of fertility behaviour, but an economic theory complemented with theories and/or ideas from other disciplines of human fertility (Easterlin, 1975) will help if not to achieve the expected result, come close to expectations.

Bongaarts (1978) also joins the debate by introducing a new dimension. According to him, all the socioeconomic and environmental variables identified has only an indirect effect on fertility. Agreeing to the negative education-fertility relationship, he went on to say that education has a negative effect on fertility through other variables like delay marriage and increased contraceptive usage. According to Bongaarts (1978), variables that have a direct effect on fertility are biological and behavioural in nature. These variables he termed as intermediated variables which are also called the proximate determinants. The

socioeconomic and environmental variables affect fertility only through their modification of these proximate determinants (Bongaarts et al., 1984). Eight intermediate variables also called the proximate determinants where lumped into three categories namely; exposure factors (proportion married), deliberate marital fertility control factors (contraception and induced abortion) and natural marital fertility factors (lactational infecundability, the frequency of intercourse, sterility, spontaneous intrauterine mortality and duration of the fertile period). Whereas a socioeconomic variable can have a positive fertility effect through a set of proximate variables, that same socioeconomic variable can have a negative fertility effect through another set of proximate determinants (Bongaarts et al., 1984). For example, education has a negative fertility effect through increase contraceptive usage and a positive fertility effect through a decrease in the length of breastfeeding. Also, the socioeconomic and environmental variables he said were made up of social, cultural, economic, institutional, psychological, health, and environmental variables (Bongaarts et al., 1984). According to Bongaarts et al. (1984), any detailed analysis of fertility should take into consideration these two categories of variables.

Easterlin (1983), in building upon the work of Bongaarts (1978) drew a distinction between intervening variables and the proximate determinants. In his model, all of the (basic) determinants of fertility (which he called basic determinants) passes through one or more of these three intervening variables; the demand for children, the supply of children and the cost of fertility regulations – simply put supply, demand and regulation cost (Easterlin, 1983; Easterlin & Crimmins, 1985). Theses intervening variables according to Easterlin (1983) also passes through the proximate determinants. Whereas the demand for children looks at the number of surviving children parents would want given that there is no cost in regulating fertility, the supply of children looks at the number of surviving children a couple would have given that the family size is not deliberately limited. The regulation cost puts

together attitudes toward and the access to fertility control methods and supplies. According to Easterlin (1983), changes in demand and regulations costs are though important, but the need for an era of a shift from social control to individual control of fertility makes changes in supply also critical. The objective of Easterlin (1983) was to develop a new link between modernization and fertility. The modernization variables (which are part of the basic determinants) included education, urbanization among others. According to the model Easterlin (1983), with modernization, the supply of children will exceed the demand for children, but due to the cost of regulation, there will be no motivation to deliberately control fertility to establish an equilibrium between demand and supply. As modernization progresses, the cost of regulation falls along with increase motivation for birth control, will call for deliberate fertility control and will cause family size to fall to the point where supply equals demand.

After Bongaarts (1978), Caldwell (1982) introduced what he called "the intergenerational wealth flow". In his exposition, changes in fertility are contingent on the direction of intergenerational wealth flow. The wealth as used by Caldwell (1982) is in the form of money, goods, services, and guarantees that an individual provides to another. Fertility will increase if wealth moves from the younger generation to the older generation and vice versa. Per Caldwell (1982), for developing countries like most countries in SSA including Liberia to experience a drop in fertility, the direction of intergenerational wealth flow should be from the older generation to the younger generation. According to him to achieve this there should be the nucleation of family.

Stemming from the objectives, this research was informed by the arguments of Bongaarts (1978), Bongaarts et al. (1984), Easterlin (1983), Easterlin & Crimmins (1985) and Leibenstein, (1974). According to these scholars, the determinants of fertility are not only

economic in nature, but also, there are social, cultural, biological among other variables that affect fertility.

3.2. Empirical

3.2.1. Education and Fertility

Education is generally known to affect many aspects of our lives. Educated women easily resolve conflict with partners through improved spousal communications (Ainsworth et al., 1996; Hossain et al., 2014), have the desire for relatively low fertility due to the relatively higher value of their time (Diebolt & Doliger, 2005; Owoo et al., 2015), decrease in the duration of postpartum factors (such as breastfeed and abstinence) (Kollehlon, 1989; Martin, 1995) among others. Whereas several of these behavioural change discourages high fertility, a number of them encourage high fertility (Martin, 1995; Snopkowski et al., 2016). The educational benefit differential is contingent on region, culture and level of development (Jejeebhoy, 1995). In addition, female education has been found to delay the onset of motherhood (Ainsworth et al., 1996; Lan & Kuang, 2016), but in the early stages of fertility transition, lower educational levels can lead to increase in fertility (Snopkowski et al., 2016). According to Martin (1995) and Murthi (2002), it is the proportion of women with education and not the average level of education that matters in reducing fertility levels. This view is supported by Bongaarts et al. (1984), who found out that literacy rate of more than 70% of women in their reproductive age for SSA was needed to realize a fall in fertility (Bongaarts et al., 1984; as cited in Ahene-Codjoe, 2007). Also, Kim (2016) demonstrated graphically that for countries with lower fertility, a greater portion of their women in their reproductive age are educated.

The relationship between education and fertility is not constant but seems to change over time (Mari Bhat, 2002). Using various surveys in India, Mari Bhat (2002) showed that even

though there remains a negative relationship between education and fertility, the extent of the inverse relationship has been decreasing over time. Also, using the concavity index, the author found that the educational-fertility relationship curvature for India has changed over time from concave to convex. This is corroborated by the dwindling negative effect of education on fertility, Kravdal & Rindfuss (2008) found in Norway. Using the various definition of fertility (Average Number of Births at Age 39, childlessness and likelihood of graduating to higher birth parity) showed that the negative effect of education has decreased over time for both men and women.

While education is known to reduce fertility, the level of education an individual requires to realize a drop in the desired fertility remains a question to be answered (Jejeebhoy, 1995). For instance, according to Snopkowski et al. (2016), any level beyond primary education should be enough in reducing fertility, whereas others have found that for developing countries secondary level education is significant enough to lower fertility (Ainsworth et al., 1996; Akmam, 2002). In Ghana, empirical evidence has shown that at least secondary education is significant in reducing fertility (Ahene-Codjoe, 2007; Benefo & Schultz, 1996; Parr, 1998), whereas one among the few empirical works in Liberia believe that any education beyond secondary level is enough to lower fertility (Parr, 1995).

Unlike Latin America where there is a wider and monotonic educational difference in fertility (Martin & Juarez, 1995), in SSA, there appears to be a weak link between education and fertility (Martin, 1995) with nonmonotonic educational differential (Weinberger, 1987). Basu (2002) in a study limited to poor, rural and illiterate societies, found corroborating evidence in support of the weak link between individual schooling and fertility. Thus in SSA, there is generally a negative relationship between education and fertility (Ainsworth et al., 1996), but at lower levels of education, education has either positive effect (Basu, 2002), weak negative effect (Martin, 1995) or has no effect (Ainsworth et al., 1996) on

fertility. Although there exists an educational differential in fertility in both urban and rural areas, there is a rural-urban difference in fertility at all educational levels. Except for a few countries in SSA where the oldest cohort does not exhibit a negative educational difference in fertility, there is a negative relationship between education and fertility in SSA which is more significant at higher levels of education across cohorts (Ainsworth et al., 1996). Also, the relatively higher educational difference in fertility for the middle age cohort as compared to the youngest cohort implies no catching up, as mentioned by some authors (Dodoo, 1993), thus increasing cohort educational difference in fertility (Ainsworth et al., 1996).

In Liberia, there are religious, ethnic and politicogeographical differences in education (Kollehlon, 1989, 1994). Catholicism, the religious subgroup with the higher proportion of its women with secondary or more education have the highest level of fertility. The other religious subgroups show no pattern of educational fertility differential (Kollehlon, 1994). In terms of ethnicity, a majority of the ethnic subgroups exhibit a negative relationship between education and fertility, with college or more education being the most significant (Kollehlon, 1989). Also, according to Parr (1995), the proportion of never-married women with children before the survey and age-standardised fertility ratios showed that pre-marital fertility was low among post-secondary educated single women. But a logistic regression showed education was not statistically significant in determining whether a single woman had a child in the previous 12 months.

Lastly, the effect of education is not always direct, education may have an indirect effect on fertility or better still may have both direct and indirect (Basu, 2002; Kim, 2016; Snopkowski et al., 2016). The presence of an indirect effect implies there is the mediation of education's effect by other variables like husband's education (Snopkowski et al., 2016), contraception (Kim, 2016; Snopkowski et al., 2016), child/infant mortality (Basu, 2002; Kim, 2016; Snopkowski et al., 2016), age at first birth (Rindfuss et al., 1980) among others.

In a situation where education has only an indirect effect on fertility, implies education's effect on fertility is fully mediated by other variables.

3.2.1.1. Husband's Education Vs. Wife's Education

Africa's unique culture which allows for distribution of cost and benefit of children to be extended to external family members (Owoo et al., 2015) also place much authority in decision making and for that matter reproduction decision making in the hands of men (Derose & Ezeh, 2005; Hossain et al., 2014; Ndjanmou, 2017), even though empirical results on the relative significance of the husband's education as against wife's education are mixed (Irani et al., 2014). This makes husband education a variable of interest. For instance, in Ghana, Derose & Ezeh (2005) using a series of logit models (both cross-sectional and pooled data) concluded that husband's education (more significant for secondary education and beyond) had a significant influence on his wife's fertility intention than his wife's own education. While in Indonesia (Breierova & Duflo, 2014), Colombia, Ecuador, Guatemala (Martin & Juarez, 1995), Pakistan (Zafar, 1996) and India (Moursund & Kravdal, 2003; Murthi, 2002) wife's education was found to be more significant in determining either fertility or desired fertility than husband's education. Also, a combination of structural equation modelling (SEM) and a Poisson regression analysis showed that whereas in rural Poland and Matlab (a rural region in Bangladesh) husband's education is a stronger predictor of fertility than wife's education, in San Borja (a town in Northern Bolivia) wife's education is a stronger predictor of her own fertility than her husband's education.

According to DeRose et al. (2002), productive work and household decision making autonomies do not imply reproductive autonomy, thus, there is not much female educational differential in reproductive autonomy. Also, according to Basu (2002), the relative significance of husband's education in determining wife's fertility depends on how mates

are selected. Men's education will have no impact on their wife's fertility if men with equal education level are randomly distributed among women of varying education levels. This will be untrue if men-women marital union is a non-random selected process, thus, a kind of assortative mating for education takes place. This assortative mating for education can be said to cause husband's education to mediate or moderate the effect of wife's education on fertility. If highly educated women are preselected to highly educated men, then given that highly educated individual have taste for smaller family size (Kim, 2016; Snopkowski et al., 2016) and prefer quality over quantity (Ahene-Codjoe, 2007). Then husbands with higher education will prefer quality but fewer children. Then husband's desire for quality but small family size will reinforce smaller fertility size aspirations of the educated wife.

Other empirical works around reproductive decision has also given mixed results. In Oyo State, Nigeria, both partners' desired fertility have an equal effect on fertility behaviour (Bankole, 1995) which is consistent with works in Bangladesh that found both partners' education to be key in their usage of contraceptives (Irani et al., 2014). Also, in the United States both husband's desire and wife's desire is equally significant in the determination of third birth, but when it comes to timing, husband desire to delay was significant in determining the rate of third birth irrespective of the timing desires of the wife (Thomson et al., 1990). While husband's education is seen be more significant in the use of contraception in Nepal (Irani et al., 2014), wife's education was seen to be more significant in India (Moursund & Kravdal, 2003) and also in a study that used two urban areas in Pakistan (Zafar, 1996). In addition, another study in Bangladesh and a study that used fourteen SSA countries concluded that wife's education or fertility desire is more significant in determining fertility than that of the husband (Irani et al., 2014).

Although the results are mixed, it suggests the importance of husbands' variables in determining fertility behaviour of their wives. The mixed result can be ascribed to

methodological differences and differences in the source of data. Whereas most of the evidence that found men to be keen in reproductive decisions uses data from Africa (Derose & Ezeh, 2005; Irani et al., 2014), evidence that supports the importance of women uses data from Asia (India to be specific) (Moursund & Kravdal, 2003). The evidence that sees both couples to be important uses data from the United States (Thomson et al., 1990) and Nigeria (Africa) (Bankole, 1995). In terms of methodology, several of them were used. It ranges from logit regression (Bankole, 1995; Derose & Ezeh, 2005; Irani et al., 2014), to the hazard model (Thomson et al., 1990) and to principal component analysis with multistage linear regression (Zafar, 1996).

Furthermore, empirical works have pointed out that the elimination of men from reproductive decision analysis will wrongly estimate the significance of variables of interest or produce results that are inconsistent (Dodoo & Landewijk, 1996; Musick et al., 2009). In a work by Ainsworth et al. (1996), it was found that for the majority of the countries, husband's education was found to be one of the significant determinants of wife's fertility, but for these same countries wife's education was more significant than husband's education in determining fertility in almost all the countries.

3.2.2. Education, Contraceptive Use and Fertility

Education is among the key determinants of modern contraceptive usage in Africa. Increase in education has a positive effect on modern contraceptive usage through the increase in or acquisition of contraceptive knowledge and improved communication between couples (Ainsworth et al., 1996; Akmam, 2002; Debpuur et al., 2002; DeRose et al., 2002; Hossain et al., 2014; Nketiah-Amponsah, Arthur, & Abuosi, 2012). According to Ainsworth et al., (1996) and Emina et al., (2014) studies in SSA have found significant positive and a monotonic relationship between female education or schooling and contraceptive usage, but

the extent of the relationship at higher levels of education varies across countries. Also, the impact of education on contraceptive usage varies with availability and location. For example, the educational effect on contraceptive usage is higher in urban areas than in rural areas. According to Ginneken & Razzaque (2003), acceptance of family planning programs begins with women with highest education. Education produce "more positive attitudes towards acceptability and increased use of contraception" (Ginneken & Razzaque, 2003; pp 42).

In Liberia, there is both contraceptive knowledge and usage differentials in terms of age, marital status, parity, religion, location and education. The main sources of contraceptives in the country are Family Planning Association of Liberia (FPAL) (40%), government-run hospitals and clinics (29%) and Pharmacies (12%) (Guttmacher Institute Digest, 1988). Educated women are more likely than uneducated women to have the knowledge and use contraceptives. A research by Nichols et al. (1987) found greater proportion of all educational sub-groups in Monrovia accepts that sexually active unmarried adolescents should practice contraception. Also, like Guttmacher Institute Digest (1988) that uses 1986 LDHS, education (either student status or educational attainment) was a source of contraceptive usage differential among sexually active adolescents in Monrovia. Females between 18 and 21 years, students or non-students with more than elementary education have the highest contraceptive usage while the lowest contraceptive usage was among non-students with low education and younger male non-student with higher education. It can be inferred from the pregnancy cases that fertility is likely to be higher among non-students than students.

Furthermore, Catholic, the religious group with a greater proportion of its women been educated and having a higher prevalence of contraceptive knowledge and usage, Catholic women have fertility (though insignificant) greater than that of women from other religious

groups (Kollehlon, 1994; Parr, 1995). Though the authors did not give a concise explanation but Kollehlon (1994) alluded to the fact that education challenges the role religion plays as a social institution by contending with religious basis for traditional family values through the promotion of secularism and generation of material expectation. Other logical reasons for the positive relation between contraception and fertility are; the lower level of polygamy among Catholic women which implies higher exposure to sexual intercourse, postpartum sexual abstinence period is relatively shorter among Catholic women and are "least likely to indicate sexual abstinence during breastfeeding" (Kollehlon, 1984; pp 497). It can be implied from the works of Kollehlon (1994) and Parr (1995) that Catholic women demand contraceptives to delay the onset of childbirth or for spacing between children to enable them to pursue their educational ambitions instead of demanding for stopping birth.

In terms of types of contraceptives, while *ever use modern contraceptive* was 16% among married women, it was only 1% for *ever use traditional method* for the same subgroup. Pill (3%) was the most used modern contraceptive (Guttmacher Institute Digest, 1988). An empirical work by Nichols et al. (1987) and the LDHS reports found the pill, male condom and injectables to be the most known method of modern method of contraceptive for females while for males, male condom and pill are the most known modern contraceptive methods. According to the LDHS reports, rhythm and withdrawal are the most known traditional method of contraceptives for both males and females (LDHS Report, 1988, 2008, 2014).

Empirical works in other countries have shown that there is educational differential in the source of either contraceptive knowledge or usage differential. While university women are more likely to use contraceptives in Kinshasa (Shapiro & Oleko, 1997), in Kenya couples with education beyond primary are more likely to use contraceptives (Irani et al., 2014). A logistic regression analysis by Hossain et al. (2014), using SDHS2005 and NDHS2006 for Senegal and Niger respectively found a couple to be more likely to approve of family

planning if the woman has a formal education than if the woman has no formal education. Using 2008GDHS, Nketiah-Amponsah et al. (2012) showed that in Ghana whereas the proportion of non-educated women using contraceptives were 1.76% and 12.93% for traditional and modern methods respectively, the proportion of primary educated women using traditional and modern methods of contraceptives were 7.44% and 18.31% respectively. This increased slightly for women with secondary education to 8.79% for traditional method and 19.8% for modern method. In San Borja and rural Poland, early knowledge about contraceptives implies early adoption (Snopkowski et al., 2016). In most developing countries like Uganda, Liberia, Zimbabwe, Sri Lanka, El Salvador among others, however, the question about the persistent huge gap between knowledge and usage of contraceptives is yet to be answered (Akmam, 2002).

Also, the effect of contraceptive usage on fertility is mixed, especially in Ghana (which is located in the same African sub-region as Liberia), whereas some empirical works have found a negative relationship between contraceptive usage and fertility (Owoo et al., 2015; Parr, 1998), others like Agyei-Mensah & Owoo (2015) have found a positive relationship. Using 1988 and 1993 Ghana Demographic and Health Survey (GDHS) data, Parr (1998) found contraceptive usage to have inhibited fertility between the two survey period. Owoo et al, (2015) also using five waves of GDHS found generally that high contraceptive usage led to lower fertility desire (even though pointed out a possibility of reverse causality). On the contrary, Agyei-Mensah & Owoo (2015) using 2008 GDHS found a rather positive relationship between contraceptive usage and fertility. According to the authors, this positive relationship between contraceptive usage and fertility may be due to the demand for spacing instead of stopping. In addition, another study found a similar positive relationship between early age of contraceptive usage and fertility in Matlab but found a negative relationship between early age of contraceptive usage and fertility in San Borja and

rural Poland. The authors gave the possibility of contraceptive demand for spacing instead of stopping as being the cause of the positive relationship in Matlab (Snopkowski et al., 2016).

Two works worth mentioning are the research conducted on the Navrongo Community Health and Family Planning Project in Ghana and the Family Planning and Health Services (FPHS) project in Matlab in Bangladesh by Debpuur et al. (2002) and Ginneken & Razzaque(2003) respectively. The authors of the Navrongo studies believe supply-side factors are required for fertility decline while the authors of the Matlab studies believe both demand-side and supply-side factors are important in reducing fertility. In the Navrongo project according to the authors, the spacing need for contraceptives remains the motivation for contraceptive demand due to the fragility of the demand. Although contraceptive usage contributes to the overall decline in fertility, their studies found delayed marriages and post-partum abstinence to be the strongest proximate determinant of fertility decline in Navrongo. The study also found contraceptive usage differential in age parity, education, religion and area of residence (whether an individual stay in the project area). In the Matlab research, the author found acceptance and usage of contraceptive to be the cause of the significant educational differences in fertility. The more positive attitudes towards acceptability and increased contraceptive usage were the result of improved education, with the highly educated women being the starting point of an attitudinal change towards family planning (Ginneken & Razzaque, 2003). On the other hand, Pritchett (1994) had in his studies found contraceptive prevalence, though significant, to have only a small effect on actual fertility when desired fertility is also a covariate in an analysis. According to him, contraception may have an effect on actual fertility, it has no significant effect on excess fertility, because there is no logical relationship between contraception and desired fertility.

In Liberia, a study by Parr (1995), found out that while contraceptive usage was lowest among Mandigo tribe and Nimba county, pre-marital fertility among single women was higher in Krahn and Via tribes and Grand Kru and Grand Cape Mount counties with Mandingo tribe being among the tribes with lower rate of pre-marital fertility. This implies a positive relationship between contraceptive usage and premarital fertility in Liberia, particularly for Mandingo tribe. Also, contraceptives use was more prevalent among single women with at least secondary education mainly to avoid disruption of education. (Parr, 1995).

In SSA where there are no strict birth control measures, education has the potential of increasing fertility since in this region a slight increase in educational asset leads to a reduction in the period of breastfeeding and postpartum abstinence (Martin, 1995). Contraception cannot be left out when inquiring about the mechanisms through which education affect fertility, thus, the effect of education on fertility may work indirectly through contraceptive usage and/or contraceptive knowledge.

3.2.3. Desired Fertility and Fertility

Given high fertility desires, measures to reduce actual fertility are likely to be insignificant (Black; as cited in Hoffman, 1974). According to Pritchett (1994), “actual fertility can be explained almost completely by fertility desire”, and that “actual fertility increases roughly one-for-one with desired fertility”. Yet empirical works on the relationship between desired fertility and fertility behaviour are mixed. Some studies have proven fertility intentions to be significant in predicting actual fertility (Adhikari, 2010; Bankole, 1995; Schoen et al., 1999), while others have found a weak link between fertility intentions and fertility behaviour (Meisenberg & Kaul, 2010; Toulemon & Testa, 2005). Among those that have found fertility desire to be an important predictor of fertility behaviour, the predictive power

weakens as the time between intentions and behaviour widens (Schoen et al., 1999). Moreover, clearer intentions (desire to have or not to have as against those who want but unsure about time and those who are uncertain about having another child or not) are more likely to realize their intentions (Bankole, 1995; Toulemon & Testa, 2005). But, the significance of desired fertility predictability is high for individuals with the desire of not having another birth (Bankole, 1995; Schoen et al., 1999; Toulemon & Testa, 2005). Furthermore, researchers believe that if fertility preferences mediate other variables, the predictability of fertility preferences will be weak or will add little or nothing to the existing knowledge on fertility behaviour (Kodzi et al. , 2010; Schoen et al., 1999).

In terms of the differential effect of desired fertility on fertility behaviour, Toulemon & Testa (2005) using longitudinal data from France between the period 1998 to 2003, found education to ensure a reliable relationship between desired fertility and actual fertility, *ceteris paribus*. They also found no difference in the predictive power of desired fertility in explaining the fertility behaviour of women in different types of a union (married and cohabiting) after controlling for age of the individual and length of a union. However, Schoen et al. (1999), using a National Survey of Families and Households (NSFH) longitudinal data for non-Hispanic Whites, found a contradictory result of that of Toulemon & Testa (2005) in terms of union type, that is, married women, rather than unmarried women, are more likely to achieve their fertility intentions.

In addition, Bankole (1995) using couples data collected in the year 1984 and 1986 in Oyo State, Nigeria found both partners' desired fertility to be equally significant in determining fertility behaviour in general. Husband's desire is more significant when there are four or fewer children in the household but as the number of children increases to five or more, the wife's desire becomes more significant in determining couples' fertility behaviour. His analysis found a result contrary to the popular saying that in SSA, men dominate in most

household affairs. Furthermore, using a national longitudinal survey of youth in 1979, Musick et al. (2009), after finding that desired fertility plays no role in explaining the educational-fertility relationship, indicated that relationship between desired fertility and fertility is limited.

3.2.4. Other Determinants of Fertility

The factors that affect fertility are enormous. It ranges from socioeconomic variables to social, environmental and institutional to health and psychological to biological and behavioural variables. Any detailed analysis should take into account all these variables. The variables most studied in terms of fertility differential are education, contraception, age at marriage, age at first birth, child or infant mortality, employment or occupation, religion, ethnicity, urbanization among others (Bhattacharya & Haldar, 2012; Pradhan, 2015). The interest of this research are education, contraception and desired fertility. To understand the relationship between these variables and fertility, all the other variables that determine fertility must be controlled for. Although dated, the empirical work by Kollehlon (1984, 1989, 1994) in Liberia have shown that in addition to education and desired fertility, ethnicity, religion, occupation, employment status, age, age square, marital status, residence, discussion of family planning with partner, among others also explain in part the difference in fertility. Empirical works in countries located within the subregion in which Liberia is located has also shown that age, child mortality, urbanization, household wealth, religion, region, ethnicity among other variables are significant in explaining fertility differentials in those countries (Agyei-Mensah & Owoo, 2015; Bankole, 1995; Benefo & Schultz, 1996). Others have found both similar and differing determinants of fertility differential (Adhikari, 2010; Bhattacharya & Haldar, 2012; Kreyenfeld, 2010; Mari Bhat, 2002).

Previous works in and out of Liberia have shown that age variables (both demographic and proximate) are significant determinants of fertility (Adhikari, 2010; Agyei-Mensah & Owoo, 2015; Benefo & Schultz, 1996; Debpuur et al., 2002; Garenne & Julien, 2008; Kollehlon, 1989; Mahy & Gupta, 2002; Parr, 1995; Snopkowski et al., 2016). In controlling for age of a woman in a fertility analysis, it is prudent to also control for the non-linearity of age (Agyei-Mensah & Owoo, 2015; Kollehlon, 1989). Empirical works on fertility have found age to be a significant determinant fertility, with older women having relatively higher fertility (Agyei-Mensah & Owoo, 2015; Debpuur et al., 2002; Snopkowski et al., 2016). Other age variables (proximate determinants) that must be considered are the age at first marriage, age at first birth and or age at first sex. Given the high prevalence of premarital fertility or *"premarital adolescent motherhood"* in Liberia (Garenne & Julien, 2008; Parr, 1995), implies the time of marriage does not affect the onset of childbearing. This means the age at first marriage will have little or no effect on the fertility outcome of women in Liberia. Holding all other things constant, later age in any of these have a decreasing fertility effect (Adhikari, 2010; Mahy & Gupta, 2002; Snopkowski et al., 2016).

Other socioeconomic variables aside education have been found to be significant in explaining fertility differential (Agyei-Mensah & Owoo, 2015; Bhattacharya & Haldar, 2012; Debpuur et al., 2002; Kollehlon, 1984). According to Bhattacharya & Haldar (2012), more female employment opportunities even at the informal sector can be used in regulating fertility. Studies both in and outside Liberia have found women employed in the non-agricultural sector to have relatively lower fertility (Agyei-Mensah & Owoo, 2015; Kollehlon, 1984). This is because the opportunity cost of childbearing and childrearing for women employed in the non-agricultural sector is relatively higher compared to women in the agricultural sector and women who are unemployed (Beatty, 2015; Lan & Kuang, 2016). Also, household wealth or ownership of assets has been found to be a determinant of fertility

differential (Agyei-Mensah & Owoo, 2015; Debpuur et al., 2002). Studies that uses data from the Demographic an Health Survey (DHS) uses household ownership of assets as a proxy for household wealth or income through the use of the Principal Component Analysis (PCA) (Agyei-Mensah & Owoo, 2015; Nketiah-Amponsah et al., 2012; Owoo et al., 2015). Increase in household income or wealth is expected to cause a decrease in fertility. This is because parents may want to invest more in the quality of their children through increased education and training (Agyei-Mensah & Owoo, 2015). According to Ahene-Codjoe (2007), when the income of household increases, parents are more likely to increase the quality of their children, due to the high-income elasticity of child-quality. Whereas Agyei-Mensah & Owoo (2015) found a high-income household to demand fewer children, Debpuur et al. (2002) found household ownership of assets to have higher fertility. Although both studies took place in Ghana, the population under study and the methodology used were different. Whereas Agyei-Mensah & Owoo (2015) ascribed the findings to the possibility of parent preferring to invest more in the quality of their children, a study in Nepal that found a similar result gave parents perceiving children as a source of income as the reason for why women from poor-income household have relatively more children. Also, according to Alaba et al. (2017), women from lower-income households sees children as a source of cheap labour.

The possible reasons for why women who live in urban areas have relatively lower fertility compared to women who live in rural area are many. According to Agyei-Mensah & Owoo (2015) it may be due to the higher costs of raising children in the urban area while according to Adhikari (2010) it is the likely of urban women using contraceptive and or the later age at which urban women marry. In addition, according to Alaba et al. (2017) a greater proportion of women residing in the rural see contraceptives as being capable of destroying the womb. Region of residence has also been found to be a significant determinant of fertility deferential (Adhikari, 2010; Agyei-Mensah & Owoo, 2015). For example, in SSA

as whole, the west has always been among the subregions with relative high fertility (Bongaarts & Casterline, 2012; Bongaarts et al., 1984). In Ghana, Agyei-Mensah & Owoo (2015) found only a small regional fertility differential after controlling for other socioeconomic and proximate determinants. This implies excluding spatial variable from a fertility analysis will leave some of the differences in fertility unexplained. Furthermore, even women who find themselves in high child mortality desire more children as a guarantee against anticipated future child deaths (Owoo et al., 2015). The experience of child deaths has been found to be a determinant of high fertility in Liberia, Ghana and Nepal (Adhikari, 2010; Agyei-Mensah & Owoo, 2015; Kollehlon, 1989).

Furthermore, a comprehensive analysis of fertility should also control for cultural and religious variables. Religion has been found to be a significant determinant of fertility in Ghana, Nigeria and Nepal (Adhikari, 2010; Alaba et al., 2017; Debpuur et al., 2002). In Nigeria and Nepal, traditional religious women were found to have relatively higher fertility than their counterparts in other religions. Alaba et al. (2017) gave conservatism and the belief concerning the use of contraceptives as some of the reasons for the high fertility among Muslims. Also, a dated work in Liberia found almost no religious difference in fertility after controlling for socioeconomic and demographic difference (Kollehlon, 1994). Ethnicity has also found to be a significant determinant of fertility differential in Ghana and Nigeria (Agyei-Mensah & Owoo, 2015; Alaba et al., 2017). According to Alaba et al. (2017), the socio-economic gap among the ethnic groups is the reason for the ethnic fertility differential in Nigeria. This corroborate the finding of Kollehlon (1989) that found socioeconomic and demographic difference to be accountable for a greater proportion of the ethnic fertility differential in Liberia.

Among the proximate variables marriage, contraceptive practices, abortion, and postpartum infecundability are strongest in explaining fertility levels and differentials (de Bruijn, 2006).

The inclusion of husband's education will cause all women without male partners to drop out, restricting the analysis of this study to only women who have marital and cohabiting experience. Abortion on the order hand is a sensitive issue for discussion in most SSA countries (Lauro, 2011; Parr, 1998), for that matter, no data was collected on abortion.

3.3. Mediation Analysis

The effect of a variable on another variable operating through other different variables is called mediation (Easterlin, 1968). Mediation analysis in terms of fertility does not always come from the mediation effect of education. The same way some variables mediate the effect of education, education can also mediate the effects of other variables (Meisenberg & Kaul, 2010) and in the same vain some variables can mediate other variables. For education mediating other variables, education mediates the effect of IQ on fertility (Meisenberg & Kaul, 2010). In the case of other variables mediating the effect of other variables, desired fertility mediate the effect of other variables on fertility (Kodzi et al., 2010; Schoen et al., 1999), marital delays and disruptions and cohabitation mediating the effect of crises on fertility (Eloundou-Enyegue et al., 2000). In addition, contraception mediating the effect of couple disagreement on fertility (Thomson et al., 1990) and the effect of IQ on fertility been mediated by family income, church attendance and gender attitude. In terms of the mediation of education's effect, empirical works have shown that any variable or part of human life that is affected by education, which in turn affect fertility behaviour or desire can also mediate the effect of education on fertility (Martin & Juarez, 1995; Snopkowski et al., 2016; Weinberger, 1987).

3.3.1. Mediation of Education Effect on Fertility

Both economic and cultural variables are important mechanisms through which education affects fertility. And failure to account for these mediation effects in the education-fertility relationship may render some variables insignificant (Akmam, 2002). Educating a woman grants her access to more and quality information, increases her human capital, makes her better home managers and raises her social status (Snopkowski et al., 2016). The variables that cause education to have an indirect effect can either be supply side or demand side variables (Basu, 2002; Kim, 2016).

Kim (2016), in explaining the complexity of the relationship between education and fertility, identified duration of a union, child mortality, length of breastfeeding and contraceptive usage as the supply-side mediators in the education-fertility relationship. On the demand side, increasing employment prospects which in turn leads to increased income for a woman and her household was the main mediating variable. Additionally, for developing countries, Basu (2002) found infant and child mortality as an important supply-side mediating variable and rising aspirations as a demand-side mediating variable.

According to Kim (2016), while some of the variables cause education to have a negative effect on fertility, others cause a positive education-fertility relationship. In support of Kim, Meisenberg & Kaul (2010) found a negative indirect effect of education through gender attitude on fertility and a positive indirect effect of education through log of house income on fertility. On the supply side, using a study from Côte d'Ivoire in 1986, Kim indicated that women aged fifty-five (55) years with lower secondary education reduced fertility on average by 0.6 children through an increase in age at cohabitation but raised fertility on average by 1.2 children through a decrease in breastfeeding. On the demand side, education leads to the securing of better jobs, which in turn leads to an increase in income. This decreases parents' reliance on children for financial support and changes their preference

for or attitude toward having a particular gender. Again, Kim indicated that in situations where there is no link between education and employment like in the case of Liberia, using Israel travelling restriction period indicated that women education may be yielding other forms of returns (like ensuring the quality of the children which will, in turn, reduce child and infant mortality) other than income. Further in support Kim, Basu (2002) found decreasing infant and child mortality and rising aspirations as being more significant in explaining the mechanisms that cause women's education to have a negative significant effect on fertility. While a decrease in infant and child mortality reduces the supply of children, rising aspirations, in turn, decreases the demand for children.

In a cross-cultural comparison using three rural locations from three continents (Asia, Europe and South America), Snopkowski et al., (2016) found education to have an indirect effect on fertility in all the three locations, but have a significant negative direct effect on fertility in two of the three locations. In addition, in all the three locations, the authors found contraceptives use along other variables to be mediating the effect of education on fertility. This according to the authors implies there are cross-cultural similarities and differences in the variable that mediate education's effect on fertility since some variables mediate in all three locations while some mediate in either one or two of the three locations. This leads to the question of whether there is also temporal similarities and differences.

3.3.2. The Link Between Education and Fertility in Liberia

The extent to which education affect various parts of our lives depends on the cultural and social atmosphere of the individual as well as the socio-economic condition of the person. The believe that the extent of education's negative effect on fertility varies across countries, implies the mechanisms through which education affect fertility is not the same in every country. According to Kollehlon (1984), in Liberia there is no link between education and

employment, meaning employment or occupation cannot be a mediating variable in the mechanism through which education affects fertility in Liberia. An empirical work in Monrovia indicated that there is high contraceptive prevalence among adolescent between age 18 and 21 who are either in school or has at least completed elementary level of education (Nichols et al., 1987). Also, an analysis in a digest of Guttmacher Institute (1988) showed that while 74% of women with at least some secondary schooling favoured the use of contraceptive only 38% of women with no education was in support of contraceptive usage. In terms of usage, 27% of women with some secondary education were using contraceptives while 7% of women with primary education and only 3% of women with no education were practicing contraception. Educated women have access to new and more information on contraceptives (either from or outside the classroom), which allows them to do away with pregnancies or the ability to space birth through the usage or increase in the usage of contraceptives. This means the highly educated women reduces fertility through the usage of contraceptives which is the result of the knowledge gain about contraceptives for being educated. Thus, education is expected to increase contraceptive usage, which in turn is expected to reduce fertility.

Furthermore, educated women are expected to have the desire for smaller family size, for the reason been that they are certain about the survival of the children (Agyei-Mensah & Owoo, 2015), childbearing or rearing comes with a higher opportunity cost (Owoo et al., 2015; Weinberger, 1987) and having knowledge about the cost that comes with each will prefer fewer but quality children (Ahene-Codjoe, 2007; Owoo et al., 2015). This makes expect fertility desire a possible mechanism through education affects fertility.

CHAPTER FOUR

METHODOLOGY

This chapter is made up of three main sections. The first section talks about the source of data including the sampling technique used in sampling as well as the key information collected during the survey. The next section deals with the econometric technique employed in this research to answer the first three research questions listed in chapter one. This section also gives a description of the variables. The last section explains the technique used in addressing the last question of the research questions, thus, the mediating analysis.

4.1. Data Source

Data used are acquired from the Liberian Demographic and Health Survey (LDHS). The DHS program data is a nationally representative survey of all regions and residence locations for women between 15 and 49 years of age. The sample is based on a stratified two-stage cluster design, where enumeration areas (EA) are drawn from census files and then a sample of households is drawn from an updated list of households from each enumeration areas. Four rounds of the survey have been conducted in Liberia, but data is available for 1986, 2007 and 2013 with a nationally representative sample of 5239, 7092 and 9239 respectively of women from selected households.

Information collected includes background characteristics, reproductive behaviour and intentions, contraception, the status of women, breastfeeding and nutrition and husband's background. With reference to background characteristics, information such as age, marital status, education, employment, media exposure, and place of residence was collected. Information on reproductive behaviour and intentions covers dates and survival status of all births, pregnancies that did not end in a live birth, current pregnancy status, fertility preferences, and future childbearing intentions. Contraceptive knowledge and usage of

specific contraceptive methods, sources of contraceptive methods, exposure to family planning messages, informed choice, and unmet need for family planning are the information collected on contraception. For women not using contraception, questions are included on knowledge of a source of contraception.

The survey collects data on the status of women and with that, questions about decision making, autonomy, ownership of houses and land, barriers to medical care, and attitudes towards domestic violence were asked. Breastfeeding and nutrition information obtained covers feeding practices, length of breastfeeding, children's consumption of liquids and solid food as well as micronutrient supplementation. Data on husband's age, education and occupation are collected under husband's background. Additional information collected during the survey includes antenatal, delivery, and postnatal care, children's health, HIV and other sexually transmitted infections and other topics like environmental health, the use of tobacco, and health insurance (The DHS Program, 2015).

4.2. Count Data Analysis

In the presence of a count dependent variable, the Poisson model or the negative binomial model is mostly used. This is because both are based on the Poisson distribution. The Poisson regression is likely to suffer from the problem of overdispersion (is corrected using the negative binomial model) and the problem of underestimating the number of zeros in the model, thus, the excess zero problem (also corrected either by using the zero-inflated Poisson model or negative binomial model). Summary statistics by Kollehlon (1989) indicated that a significant proportion of Americo-Liberian has a fertility of either zero or less than three children. On the contrary, a significant proportion of other (five) tribes selected for his studies have a fertility of three or more children. With such differences in fertility, it is likely for the dependent variable to suffer from overdispersion, meaning the

assumption of equidispersion as assumed by the Poisson regression may not hold. If the assumption of equidispersion does not hold, then it is prudent to use the negative binomial regression model. Nonetheless, the proportion of Americo-Liberian as defined by Kollehlon (1989) in the total sample of the data employed in this study is small (0.44%, 3.07% and 2.51% for 1986LDHS, 2007LDHS and 2013LDHS respectively). This makes it difficult to conclude with certainty, whether the Poisson or negative binomial regression is appropriate for the data sets. But, the decision between the two regression methods can be settled in two ways; first, is by running a post-estimation test to check for the goodness-of-fit for the Poisson regression. The Poisson is appropriate if the result from the goodness-of-fit test is not significant ($p>0.05$) (Institute for Digital Research and Education (IDRE), 2017; StataCorp, 2015). Second, estimation of the negative binomial regression in STATA, also tests whether the assumption of equidispersion holds (by testing whether the alpha is statistically different from zero). The Poisson is appropriate if the alpha is not significantly different from zero (Institute for Digital Research and Education (IDRE), 2017; Katchova, 2013). These help in determining which of the two, Negative Binomial regression or Poisson regression is suitable for the data set under examination.

Fertility as measured by the number of children ever born, was used as the dependent variable while wife's education, husband's education, contraceptive usage and fertility desire were used as independent variables. Age, age at first birth, location (urban-rural), religion, ethnicity, occupation among other variables were employed as control variables.

The Poisson, like the Negative Binomial, has the same probability equation as represented in equation 1 below

$$Pr(Y = y) = \frac{e^{-\mu}\mu^{y}}{y!} \quad \text{----------} \quad (1)$$

$$\text{where } \mu = \text{esp}(x'_i\beta) = \exp\left(\beta_0 + \sum_{j=1}^{K} \beta_j x_{ij}\right)$$

One of the assumptions that differentiate the Negative Binomial Regression (NBR) from the Poisson Regression is the assumption about the dispersion of the data, while the negative binomial assumes overdispersion of the data, the Poisson regression assumes equidispersion of the data.

$\text{E}(y_i|x) = \mu = \text{Var}(y_i|x) = \mu + \alpha\mu^2$, where $\mu > 0$, $\alpha = 0$ ..... for equidispersion

$\text{E}(y_i|x) = \mu < \text{Var}(y_i|x) = \mu + \alpha\mu^2$, where $\alpha, \mu > 0$ ..... for ovedispersion

$\text{E}(y_i|x) = \mu > \text{Var}(y_i|x) = \mu + \alpha\mu^2$, where $\alpha > 0$, $\alpha < 0$ ..... for underdispersion

The coefficient of the negative binomial regression is estimated as follows;

$$\text{Yi} = \text{E}(Y_i) + u_i = \mu_i + u_i$$

$$\mu_i = E(Y_i) = esp(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_K X_{Ki}) \text{ \_\_\_\_\_ (2)}$$

Substituting the variables of this research into equation (2);

$$\begin{aligned}\mu_i = E(&wife's\ fertility) \\ &= exp(\beta_0 + \beta_1 Wife's\ Education + \beta_2\ Husband's\ Education \\ &+ \beta_3\ Contraceptive\ Usage + \beta_4\ Desired\ Fertility + \beta_5\ Age \\ &+ \beta_6\ Age^2 + \beta_7\ Age\ at\ 1st\ birth + \beta_8\ age\ at\ 1st\ sex/intercourse \\ &+ \beta_9\ Urban\ residence + \beta_{10}\ Child\ Deaths + \beta_{11}\ Religion \\ &+ \beta_{12}\ Ethnicity + \beta_{13}\ Region + \beta_{14}\ Occupation \\ &+ \beta_{15}\ Household\ inome/wealth)\end{aligned}$$

After estimation of the Poisson regression, the betas or coefficients (β_i) are interpreted as;

For continuous variables, for example age, all other variables being held constant, an increase in age by a year will lead to β_5% increase/decrease in fertility.

For dummy/categorical variables, for example place of residence which takes on values 0 for rural and 1 for urban will be interpreted as, all other variables being held constant, women who are urban resident will have β_9% fertility greater/lesser than women who are rural resident.

4.2.1. Variable Description and Summary Statistics

This section presents a description and summary statistics of variables used in this study. Table 5.1 reports summary statistics of variables used in the analysis.

Fertility - Fertility is measured as number of children ever born (CEB). The average fertility as measured by the number of CEB has decreased from 3.12 children in 1986 to 2.89 children in 2013.

Education - The education levels for both husband (*partner* for unmarried but cohabiting women) and wife were used as the measure of education in the regression analysis. This is because 1986 LDHS unlike 2007 LDHS and 2013 LDHS, does not have information on *educational attainment*, but all three waves have information on *education level*. The inclusion of a husband variable restricted the analysis to women who are married and women who are cohabiting (living together with a man as though married). Therefore, women in this context are wives and or women who are cohabiting. This by extension defines men as the husbands and partners of women in these categories. Education level has been categorized into *no education*, *primary*, *secondary* and *higher*, but for this study, secondary and higher were merged together as *secondary and beyond*. Education, especially for the wife, has a negative effect on fertility (Ainsworth et al., 1996; Basu, 2002;

Snopkowski et al., 2016), but at the lower levels, education can have a positive effect on fertility (Basu, 2002). The proportion of the educated has increased for both women and their husbands. For women, the proportion of women with primary education or more has increased from 37.3% to 57.6% and to 66.8% in 1986, 2007 and 2013 respectively whereas for their husbands, the proportion with primary or more education has increased from 69.8% in 1986 to 79.1% in 2007 and to 84.2% in 2013. The proportion of women with more than secondary education and beyond has increased from 19.0% in 1986 to 35.7% in 2013 while that of men has increased from 26.5% in 1986 to 40.7% in 2013.

Contraception – In terms of contraceptive usage, since this study is not interested in the effectiveness of the various types of contraceptives, data on *contraceptive use and intention* was adopted, recoded and used as the measure of contraceptive usage. Thus, data on contraceptive use and intention is coded as *using modern method, using traditional method, non-user intend to* and *does not intend to,* but the non-user intend to and does not intend to ware recoded as *not using any method* while using modern method and using traditional method remain as they are. In terms of contraceptive knowledge, every wave comes with its own categorization. 2013 wave was categorized into *knows no method* and *knows modern method*. On the other hand, 2007 wave was categorized into *knows no method, knows only folkloric, know only traditional method* and *knows modern method* while 1986 wave was categorized into *knows no method, know only traditional method* and *knows modern method.* For the sake of consistency, all waves were recoded into *knows no method* and *knows a method*. The usage of contraceptive should have a negative effect on fertility, but it may have positive effect when it is been used for spacing births. There is a large gap between knowledge and usage of contraception. While the proportion of women with knowledge of contraception was 71.8%, 86.8% and 98.2% in 1986, 2007 and 2013 respectively, the

proportion of women using any form of contraceptive was 8.4 % in 1986, 13.3% in 2007 and 21.7% in 2013.

Desired Fertility – the ideal number of children was used as the measure of desired fertility. The challenge in using variables like the ideal number of children is the presence of missing values and non-numeric answers like "any, as God sends" in the ideal number of children variable. In DHS, missing values and non-numeric answers are given different codes. For instance, missing values are coded 9999, 999, 99 or 9 while don't know answers are coded 9998, 998, 98 or 8 (The DHS Program, 2013). According to Pullum (2015), there is no clear-cut rule about how to handle such answers, but in a quantitative analysis, non-numerical answers should be coded as missing. For this reason, non-numerical answers like "don't know" and "any, as god sends" in the ideal number of children variable and others variable were coded as missing. The average ideal number of children has decreased from an average of 5.98 children per woman in 1986 to an average of 4.33 children per woman in 2013.

Age – Current age of respondents are between 15 and 49 years. Age square is included in the analysis to control for the non-linear relationship between age of women and their fertility (Agyei-Mensah & Owoo, 2015; Kollehlon, 1989). The average age of women has been in the neighbourhood of 27 to 29 years for all three waves.

Age at first birth and age at first sex – The age at which the respondent has her first birth is used as the measure of age at first birth whereas the age at which an individual had her first sexual intercourse is used as the measure for age at first sex. Age at (first) marriage is not considered here because of the high *"premarital adolescent motherhood"* in Liberia (Garenne & Julien, 2008; Parr, 1995). So instead of using age at (first) marriage or cohabitation, age at first sex was used. Women who have either later age at first birth or later age at first sex are expected to have relatively lower fertility. The average age at which women had their first birth in Liberia has dropped slightly from 18.7 years to 18.4 years

whereas the average age at which the women begin sexual activities has increased slightly from 14.3 years to 14.7 years from 1986 to 2013.

Child Deaths – there is no direct information or question on the total number of children not living or dead. To arrive at the number of dead children (as a measure of child mortality) for each woman, the *number of living children* is subtracted from the *total (number of) children ever born* or better still the addition of *sons who have died* and *daughters who have died*. The higher the number of child death, the greater the number of CEB a woman is expected to have. The average number of child deaths is less than one child for all three waves and has decrease from an average of about 0.8 child deaths per woman in 1986 to an average of about 0.5 child deaths per woman in 2013.

Residence – whether individual lives in an urban area or lives in a rural area. Women who lives in the urban area are expected to have lower fertility than their counterparts who lives in the rural area due to the higher costs of child nurturing in urban areas. Whereas women residing in rural areas were more than women residing in urban areas in 1986 and 2007 (57% and 58% respectively), in 2013 women who were residing in urban areas were more than women residing in rural areas, representing an increase in urbanization over time.

Religion – In terms of religion, Liberia can be grouped into five, namely; Christian, Muslim, Traditional, Other Religion and No Religion. This grouping is consistent with the 2007 and 2013 waves of the LDHS. 1986 LDHS had Protestant, Catholic, Muslim, Traditional, Other Religion and No Religion, but for the sake of consistency with the other two waves, the Protestant and Catholic are combined to form Christian as in the 2007 and 2013 waves. Also, due to the smaller proportion of women belonging to traditional, other and no religion, they were lumped together as one. Christian women, especially Catholics, have relatively higher levels of education (Kollehlon, 1994; Parr, 1995). For this reason, Christians women are expected to have lower fertility than women in other religions.

Table 4.1: Summary Statistics of Variables

Variables	1986LDHS				2007LDHS				2013LDHS			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Fertility (No. of Children Ever Born)	3.12	2.91	0	17	3.10	2.78	0	15	2.89	2.72	0	17
Wife's Education												
No Education	0.63	0.48	0	1	0.42	0.49	0	1	0.33	0.47	0	1
Primary	0.18	0.39	0	1	0.33	0.47	0	1	0.31	0.46	0	1
Secondary and Beyond	0.19	0.39	0	1	0.25	0.43	0	1	0.36	0.48	0	1
Husband's/Partner's Education												
No Education	0.30	0.46	0	1	0.21	0.41	0	1	0.16	0.36	0	1
Primary	0.07	0.25	0	1	0.14	0.34	0	1	0.11	0.32	0	1
Secondary and Beyond	0.26	0.44	0	1	0.37	0.48	0	1	0.41	0.49	0	1
Contraceptive Usage												
Not using any method	0.92	0.28	0	1	0.87	0.34	0	1	0.78	0.41	0	1
Use Modern Method	0.07	0.25	0	1	0.12	0.32	0	1	0.21	0.40	0	1
Using Traditional Method	0.01	0.12	0	1	0.02	0.12	0	1	0.01	0.11	0	1
Knows a Method of Contraceptive	0.72	0.45	0	1	0.87	0.34	0	1	0.98	0.13	0	1
Desired Fertility (Ideal No. of Children)	5.98	2.94	0	25	5.00	2.28	0	25	4.83	2.22	0	30
Age	27.87	9.12	15	49	29.40	9.70	15	49	28.56	9.66	15	49
Age at first birth	18.68	4.11	10	42	18.67	3.73	11	44	18.42	3.45	6	42
Age at first sex	14.34	3.40	0	37	15.10	3.98	0	40	14.66	4.39	0	30
Urban Residence	0.43	0.50	0	1	0.42	0.49	0	1	0.61	0.49	0	1
Child Deaths	0.78	1.32	0	14	0.59	1.14	0	10	0.49	1.02	0	10
Ethnic Group												
Other Tribes	0.05	0.21	0	1	0.04	0.20	0	1	0.06	0.24	0	1

Kru Tribes	0.36	0.48	0	1	0.31	0.46	0	1	0.29	0.45	0	1
Mande-Fu Tribes	0.42	0.49	0	1	0.49	0.50	0	1	0.48	0.50	0	1
Mande-Ta Tribes	0.10	0.30	0	1	0.07	0.26	0	1	0.09	0.28	0	1
Mel Tribes	0.08	0.27	0	1	0.08	0.27	0	1	0.08	0.27	0	1
Region												
South Central	0.44	0.50	0	1	0.47	0.50	0	1	0.53	0.50	0	1
North Western	0.06	0.24	0	1	0.07	0.26	0	1	0.09	0.29	0	1
North Central	0.36	0.48	0	1	0.34	0.47	0	1	0.27	0.44	0	1
South Eastern A	0.10	0.30	0	1	0.05	0.22	0	1	0.05	0.22	0	1
South Eastern B	0.03	0.18	0	1	0.06	0.24	0	1	0.06	0.24	0	1
Religion												
Christian	0.54	0.50	0	1	0.85	0.36	0	1	0.86	0.35	0	1
Muslim	0.14	0.35	0	1	0.10	0.30	0	1	0.11	0.31	0	1
*Others (*including Traditional*)*	0.31	0.46	0	1	0.04	0.20	0	1	0.03	0.17	0	1
Occupation												
Not Working					0.35	0.48	0	1	0.43	0.49	0	1
Agricultural					0.36	0.48	0	1	0.23	0.42	0	1
Non-Agricultural					0.35	0.48	0	1	0.34	0.47	0	1
Household Income												
Low	0.39	0.49	0	1	0.44	0.50	0	1	0.44	0.50	0	1
Middle	0.37	0.48	0	1	0.42	0.49	0	1	0.11	0.31	0	1
High	0.24	0.43	0	1	0.13	0.34	0	1	0.44	0.50	0	1

Most of the women in Liberia are Christians. Except for the 1986 wave, Muslims recorded the second highest (10% and 11% in 2007 and 2013 respectively), with other women which includes those traditional worshippers recording less than 5% in 2007 and 2013.

Ethnicity – The 1986 and 2007 waves have eighteen tribal groups while the 2013 wave has 19 tribal groups, and this is because Kru and Sarpo tribes were merged as one ethnic group in the 1986 LDHS but were split in the 2013 LDHS. To ensure consistency, the Kru and Sarpo in the 2013 LDHS are merged together as one tribe. Also, *None* or *Only English* was renamed Americo-Liberian because *"overwhelming majority of native-born Liberians with no tribal affiliation are Americo-Liberians"* (Kollehlon, 1989; pp71). This will put Liberia into the following tribal groups; Bassa, Bella, Dey, Gbandi, Gio, Gola, Grebo, Kissi, Kpelle, Krahn, Kru/Sarpo, Lorma, Mandingo, Mano, Mande, Vai, Other Tribes and Americo-Liberian. Liberia is made up of three major language ethnic groups namely; Kru, Mande and Mel but Mande can be subdivided into Mande-Ta and Mande-Fu. This study collapsed the tribes into five language ethnic groups namely; Kru Tribes (Bassa, Bella, Dey, Grebo, Krahn and Kru/Sarpo), Mande-Fu Tribes (Gbandi, Gio, Kpelle, Lorma, Mano and Mande), Mande-Ta Tribes (Mandingo and Vai), Mel Tribes (Gola and Kissi) and Other Tribes (Americo-Liberian and all other tribes). For all the three waves, more than 40% but less 50% of the women were from Mande-Fu tribes while Mande-Ta tribes, Mel tribes and all other tribes each represent less 10% of the entire population. The proportion of women from the Kru tribes is in the neighbourhood of 28% to 36%.

Region – there are fifteen political regions (called counties) in Liberia namely; Montserrado, Boni, Bong, Grand Bassa, Grand Cape Mount, Grand Gedeh, Grand Kru, Margibi, Maryland, Nimba, River Cess, Sinoe, River Gee and Gbarpolu. But River Gee and Gbarpolu counties are not in 1986LDHS, making it have only thirteen counties. This study collapsed the fifteen counties into five regions as done by the DHS. The five regions are

North Western (Bomi, Grand Cape Mount, and Gbarpolu), North Centra (Bong, Nimba, and Lofa), South Central (Montserrado, Margibi, and Grand Bassa), South Eastern A (River Cess, Sinoe, and Grand Gedeh) and South Eastern B (River Gee, Grand Kru, and Maryland). Each of the five regions is made up of three counties with Montserrado where the capital city is located been part of the South-Central region. The proportion of women from the South-Central region alone is more 44% for all the three waves. Also, whereas the North-Central region has the second highest proportion of women, North-Western, South-Western A and South-Western B have, almost for all the three waves, less 10% of the women coming from each of these regions.

Household Wealth – The demographic and health surveys collect no information on income and wealth, so household wealth is proxied with an index of wealth or ownership of a number of assets (Nketiah-Amponsah et al., 2012). Using Principal Component Analysis, women of reproductive age are categorized into lower, middle or higher wealth categories based on ownership of some assets collected during the survey (Agyei-Mensah & Owoo, 2015). The number of assets that were used as a measure of wealth varies depending on the number of assets a particular wave of the LDHS collected data on. 1986 wave has data on only two assets, 2007 wave has data on seven while 2013 wave has information on sixteen assets. Women from higher income/wealth household are expected to have lower fertility than women from other household income/wealth categories. The proportion of women from low-income households (39% in 1986 and 44% in 2007 and 2013) were more than women from other household income categories for the three waves. Whereas women from middle-income households recorded the second highest in 1986 and 2007, women from high-income households were equal to women from low-income households in 2013.

Occupation – information here is based on the sector of employment during the last twelve months preceding the survey (The DHS Program, 2014). The subcategories are *not working*,

professional/technical/managerial, *clerical*, *sales*, *agricultural (self-employed)*, *agricultural (employee)*, *household & domestic*, *services*, *skilled manual*, *unskilled manual* and *other*. This was coded into *agricultural*, *not working* and *nonagricultural*. Women who fall within the non-agricultural occupational category are women in the professional jobs, technical jobs, managers, skilled and unskilled manual workers, services, clericals among others. The not working category is made up of women who are not actually working and students. The proportion of women not working (36%) was greater than women in other working categories (agricultural and non-agricultural) in 2013 while the women who were working in the agricultural sector recorded the highest (43%) in 2007.

4.2.2.Issue of Endogeneity

One important issue of concern is the issue of endogeneity caused by reverse causality between fertility and contraceptive usage. That is, whereas an individual who uses contraceptives are expected to have lower fertility, one can also say that an individual's fertility aspiration or the number of children an individual has determines her usage of contraceptive. Additionally, while studies in fertility employs contraception as a covariate (Agyei-Mensah & Owoo, 2015; Irani et al., 2014; Owoo et al., 2015; Parr, 1998; Shapiro & Oleko, 1997; Tawiah, 1984), studies in contraception uses either fertility desire or behaviour as a covariate (Anasel & Mlinga, 2014; Nketiah-Amponsah et al., 2012; Worku et al., 2014).

To address the problem of endogeneity, a variable which is a determinant of the endogenous covariate and not a determinant of the dependent variable as well as being uncorrelated to the error term is required. The issue of reverse causality has been raised (Garenne & Julien, 2008; Owoo et al., 2015), but the possibility of occurrence does not imply it actually occurs in every situation or dataset. Endogeneity caused by reverse causality when present may cause estimators to be biased and inconsistent. A search through the data gave no suitable

variable that qualifies as an instrument. The other variables employed in this study as controls are also usually the variables used as covariates in contraception studies. This makes this study incapable of considering an attempt of testing and resolving any available endogeneity problem that is likely to occur.

4.3. Mediation Analysis

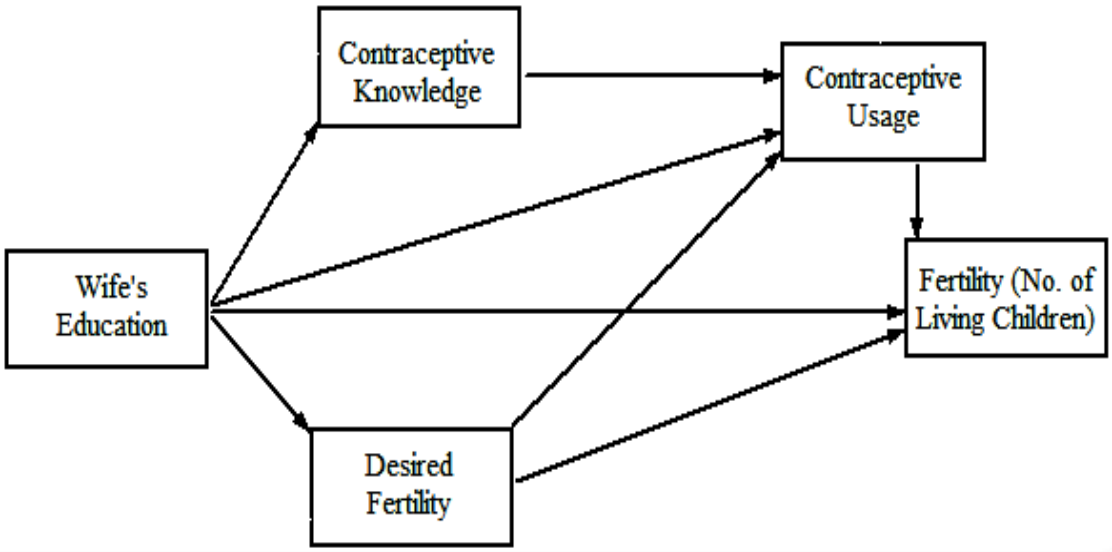
To check the mediating effects of contraception (knowledge and usage) and desired fertility, either a test is conducted, or a model is estimated to allow for the estimation of an indirect and a direct effect of education and the other variables on fertility. Three tests or approaches are plausible; Baron & Kenny's Procedures for Mediational Hypotheses, Sobel-Goodman mediation tests and the Structural Equation model (SEM). A number of concerns have been raised on the Baron & Kenny's Procedures (Zhae et al., 2010), while Sobel-Goodman mediation tests will be appropriate for testing whether any of the variables of interest mediate the effect of education on fertility (Bruin, 2006), but to have a clearer picture of how all the other variables of interest mediate the effect of education on fertility, the structural equation model (SEM) is appropriate (Zhae et al., 2010). The SEM is able to obtain the direct, indirect and total effects of an independent variable (education) on an outcome variable (fertility) through the estimation of series of regression models and allow for the comparison of the relative strength of the mediating variables (Snopkowski et al., 2016). Structural equation modelling (SEM) provides a framework in which a family of statistical methods that allow a collection of equations with accompanying assumptions of the analyzed system, in which the parameters are determined based on a priori relationships among a set of variables. The variables can be observable or latent and the relationship can be between one or more independent variables and one or more dependent variables. Complex interactions are first visualized in a network of directional paths (which

hypothesize direct and indirect effects) linking variables and then estimate them against a multivariate data. While a direct regulation of an endogenous (dependent or causal) variable by an exogenous (independent or response or effect) variable is a direct effect, the mediation of the regulation by other variables is called indirect effect (Gray & Gray, 2017; Hox & Bechger, n.d.; Lam & Maguire, 2012; Tarka, 2018).

4.3.1. The Pathway

The pathway model in Figure 4.1 is based on knowledge from existing empirical works in Liberia (Kollehlon, 1984; Nichols et al., 1987) and works done in other countries, especially that of Snopkowski et al. (2016) and DeRose et al. (2002).

Figure 4.1: The Pathway



Source: Author

From Figure 4.1, wife's education has a direct effect on fertility and an indirect effect through desired fertility and contraception. The indirect effect of wife's education is through contraceptive usage, contraceptive knowledge and desired fertility straight to fertility. Also, in a situation where women of the same age have the same access or predispose to the same

level of contraceptive knowledge like the case of Matlab (Snopkowski et al., 2016), wife's education is expected to be the cause of the difference in contraceptive usage. That is, wife's education has both direct and indirect effect on both contraceptive usage and fertility, but the interest here is on fertility and not on contraceptive usage.

4.3.2. Challenges of using Structural Equation Model (SEM)

The use of SEM requires three assumptions, they are; large sample size, multivariate normality and correct specification of the model. The sample sizes from the different waves of the data used are adequate or pass the large sample size assumption. The multivariate normality assumption can relax, especially for the exogenous variable(s) (Huber, 2016). In this study under the SEM analysis, wife's education, contraceptive knowledge, contraceptive usage, desired fertility and fertility were used. Out of these, contraceptive knowledge and contraceptive usage are discrete in nature and for the continuous variables, all variables (education for both wife and husband and desired fertility) take on positive values with none having a shape close to bell-shape. Thus, multivariate though, there is no normality in the variables used for this analysis.

There are two possible ways for controlling or correcting for the non-normality of the variables. First is to use the generalized structural equation model (GSEM) which allows for controlling for discrete or un-continuous and non-normality nature of the variables. But for the purpose of this study, the GSEM cannot be used because there is no collaborative measure of goodness-of-fit for GSEM (Huber, 2016) and also does not allow for the decomposition of the total effect into direct and indirect effects. Second is to bootstrap. Bootstrapping is used in correcting for nonnormality of the variable(s) in a statistical analysis where the assumption of normality of data or variables must hold (Hu, 2010). Especially, in this case where some variables are categorical while others count in nature.

But to use bootstrapping on a survey data, the data file must also come with a bootstrap weight variable (Gagné et al., 2014). Both the survey weight and bootstrap weight are used in survey setting the data to enable the control of sampling technique and the non-normality of the variable in any statistical analysis. The DHS data sets do not contain a bootstrap weight variable. So, though the complex sampling technique can be controlled for, the non-normality of the variable used cannot be controlled for.

The objective of this section is to determine whether education's effect on fertility is fully mediated by contraception and desired fertility, thus, whether education has only a direct effect, only an indirect effect or both direct and indirect effects on fertility. For this reason, the SEM without bootstrapping analysis was used even though it does not control for the nature of the variables used. Also, as mentioned in section 4.1.1 about the issue of missing data, the SEM analysis gives the option of whether to take missing values into account in its analysis. So, all SEM analysis took care of the missing values in the data.

CHAPTER FIVE

ANALYSIS AND DISCUSSION OF RESULTS

5.1. Introduction

This chapter is divided into two main sections. The first section presents bivariate statistics of variables of interest. The next section which is the empirical analysis is also in two parts. In the first part of this section, a count data analysis, Poisson regression to be specific, was used in answering the first three research questions of this study. The part two of the last section employs the SEM analysis in answers the last research question.

5.2. Bivariate Analysis

Figure 5.1 presents a bivariate statistic between fertility and education for both husband and wife, contraceptive usage and desired fertility. Since the fertility variable is continuous, the best bivariate statistic that can be produced is the one that allows for a comparison between the various educational, contraceptive usage and desired fertility categories. And having three waves, trends can also be considered.

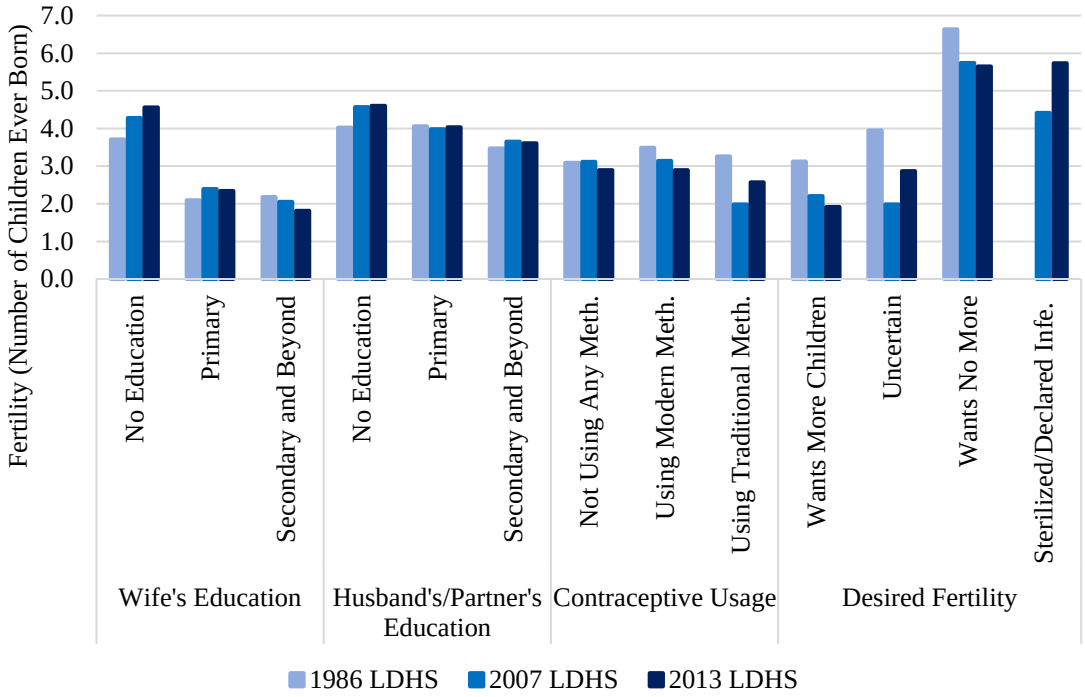
To begin with, for all the three waves, women with relatively higher education have relatively lower average fertility. In terms of the trend in average fertility for the various categories of wife's education, where the average fertility of women with no education and primary education have increased, the average fertility of women with secondary education and beyond has decreased. Whereas women with secondary education and beyond appears have had a monotonic decrease in fertility, women with no education appears have a monotonic increase in fertility.

For husband's education, women whose husbands have higher education have relatively lower average fertility, except for 1986 wave were their pattern changes slightly. In term of the trend, women whose husband has no education had a continuous increase in average

fertility over the three waves but the increase between 2007 and 2013 waves is relatively small. Women whose husband have primary education or more have had a nonmonotonic trend.

Contraceptive usage differential in fertility has neither a pattern or a clear-cut trend, except for women who uses modern contraceptives who had a continous decrease in avearge fertility over the three waves. For 1986 and 2007 waves, women who were using a modern method of contraceptive had the highest average fertility. Whereas women who were not using any method had the lowest average fertility in 1986, women who were using a traditional method of contraceptive has the lowest average fertility in 2007 and 2013.

Figure 5.1: The Average Number of Children Ever Born (Fertility) for Wife's Education, Husband's Education, Contraceptive Usage and Desired Fertility



Desired fertility like contraceptive usage shows no pattern in average fertility differential. Women who want more children and women who do not want more children had a continuous decrease in average fertility, but the extent of the decrease has not been uniform. Whereas women who want more children had the lowest average fertility in 1986 and 2013

waves, women who do not more children had the highest average fertility for 1986 and 2007 waves. For the three waves, the average fertility of women who wants no more children was greater than that of women who want more children. Women who are uncertain about their desired fertility and women who have been sterilized or declared infecund had an increase in average fertility between 2007 and 2013.

5.3. Empirical Analysis

5.3.1. Poisson Regression

Poisson goodness-of-fit test after a Poisson regression or a test of overdispersion after the Negative Binomial regression can be used in determining whether Poisson or Negative Binomial is most appropriate for a particular count data analysis. For the Poisson goodness-of-fit test, the rule of thumb is that when the test is statistically insignificant, it means the Poisson is the appropriate technique. On the other hand, when the test is significant it means the negative binomial regression will be an appropriate statistical technique for the data set. The Poisson goodness-of-fit test for all the three waves was in support of the use of the Poisson regression technique (See Table 5.1).

Table 5.1: Poisson Goodness-of-fit Test

	1986	**2007**	**2013**
Pearson goodness-of-fit	1194.643	1967.557	2403.716
Prob > chi2	1.0000	1.0000	1.0000

The result from the Poisson regression is presented in Table 5.2. Beginning with education, in 1986, husband's education was overall significant (at 1%) in explaining fertility than wife's own education. All levels of husband's education had a significant positive effect on fertility. Women with primary education were having significantly more CEB than women with no education. The increasing fertility effect of a wife's primary education found here corroborates with Basu (2002). In 2007, wife's education was overall significant (at 1%) in

explaining fertility while husband's education did not have any significant effect on his wife's fertility. Women with secondary education and beyond had significantly fewer CEB than women with no education. In 2013, both wife's education and husband's education were overall significant in explaining fertility. Although secondary education and beyond had a significant negative effect on fertility for both husband and wife, the magnitude and the level of significance of the wives was higher than that the husbands. The result from 1986LDHS corroborates the literature that found husband's education to be significant than wife's education in explaining fertility (Derose & Ezeh, 2005). On the other hand, the results from 2007LDHS and 2013LDHS corroborate the studies that found wife's education than husband's education to be more significant in explaining fertility (Breierova & Duflo, 2014; Mari Bhat, 2002; Martin & Juarez, 1995; Moursund & Kravdal, 2003; Murthi, 2002; Zafar, 1996). For wife's education, secondary education and beyond, significant or insignificant, has a fertility-reducing effect whereas for husband education, except for secondary education and beyond for 2013LDHS, all levels of education, significant or insignificant, has an increasing effect on fertility. In addition, for 2013LDHS all levels of wife's education have a negative effect on fertility. The significance of wife's education found in this study contradicts the findings of Parr (1995) who found only education beyond secondary education to be significant in reducing fertility.

Furthermore, the level of wife's education that has a negative effect on fertility has evolved from only secondary education and beyond in 1986 and 2007 to all levels of education in 2013. On the other hand, the significance of wife's education has evolved from a significant positive effect of primary education in 1986 to a significant negative effect of secondary education and beyond in 2007 and 2013. An explanation to this trend is likely due to the increase in the proportion of educated women over time, which corroborates Martin (1995) and Murthi (2002) belief of education being more effective in reducing fertility if a greater

proportion of women have an education instead of just a few having too much of it. Also, this trend of increasing negative education-fertility relationship is opposite to decreasing negative educational-fertility relationship Kravdal & Rindfuss (2008) found in Norway. This study found education, specifically secondary education and beyond, to have an increasingly negative effect on fertility over time. Husband's education was for 1986LDHS and 2013LDHS part of the variables that were significant in explaining the fertility of Liberia. This supports the findings of Ainsworth et al. (1996) and the beliefs of others (Bankole, 1995; Dodoo & Landewijk, 1996; Musick et al., 2009) on the importance of including men in reproductive decision analysis. The reasons for the trend in the significance and signs of husband's education in this study is hard to explain. The insignificance of husband's education in predicting fertility in 2007 may be due to the after-war uncertainties which may have given more control over the reproductive decision to women complemented by an increase in the proportion of women with education. Reduced uncertainties and or improve communication between couples resulting from increased education of women may be the reason for the significance of husband's education in 2013. Generally, the fertility effect of wife's secondary education and beyond have become increasingly negative. The effect of education both husband and wife, have become less positive for the levels of education that has a positive effect as well as turned negative for some levels which previously have a positive effect.

Desired fertility has for all the three waves been a significant (at 1% for all waves) determinant of fertility in Liberia like Bankole (1995) and Schoen et al. (1999) found in their studies in Oyo State, Nigeria and the United States respectively. Increase in the ideal number of children by one led to a significant increase in the number of CEB by 1.53%, 2.56% and 2.72% respectively in 1986, 2007 and 2013. This is less than what Pritchett (1994) said concerning the fertility effect of desired fertility. According to Pritchett (1994),

an increase in desired fertility by a child should increase the number of CEB by almost one child.

Contraceptive usage was overall significant in explaining fertility in Liberia for all the three waves. For all the three waves, women who use modern contraceptives were having significantly higher fertility than women who do not use any method of contraceptive. Whereas the significance agrees, the size of the coefficient of modern contraceptive use is not the same as what Pritchett (1994) found in his studies. According to Pritchett (1994), in the presence of desired fertility as a covariate, contraceptive usage, although may be significant, will have only a negligible effect on fertility. The positive fertility effect of modern contraceptive use may be due to the demand for spacing birth and not for limiting birth or possibly its likely to be used to prevent the disruption of education or other engagements (Agyei-Mensah & Owoo, 2015; Debpuur et al., 2002; Parr, 1995; Snopkowski et al., 2016). The study by Nichols et al. (1987) alluded to the prevalence of sexually active adolescents in Liberia. Given that pregnant adolescents secondary schools are not allowed to continue their studies (Parr, 1995), then these sexually active adolescents who are still at the secondary school level explains if not in full, part of the positive relationship between modern contraceptive usage and fertility. On the other hand, usage of a traditional method of contraceptive has a significant positive effect on the number of CEB for only 2013.

Age has a significant positive effect on fertility, but this positive effect decrease with age implying a non-linear relationship between age and fertility found by other empirical works (Agyei-Mensah & Owoo, 2015; Owoo et al., 2015). The significant negative age-fertility relationship found in this study corroborate with the finding of other empirical works in Ghana and other countries (Agyei-Mensah & Owoo, 2015; Benefo & Schultz, 1996; Debpuur et al., 2002; Snopkowski et al., 2016). The effect of age on fertility has diminished over time, thus, increase in fertility on average resulting from a unit increase in age has

decreased from 18.3% in 1986 to 16.8% in 2013. On the other hand, the age at which an increase in age will cause a decrease in fertility has increased from 43.99 years in 1986 to 45.90 years in 2013. Further, higher age at first birth is significantly negatively correlated with fertility. Firth birth at a later age in life leads to fewer CEB in Liberia as found by other researchers (Adhikari, 2010; Mahy & Gupta, 2002; Snopkowski et al., 2016). Holding all other things constant, a year delay in first birth will reduce the number of CEB on average by about 4%.

Except for 1986LDHS, urban residency has a significant negative effect on fertility. Women who lived in urban areas had 7.65% and 6.81% fertility less than women who lived in rural areas in 2007 and 2013 respectively. The high cost of living in the urban areas (Agyei-Mensah & Owoo, 2015) and or the belief about the usage of contraceptive in the rural areas (Alaba et al., 2017), may be the cause of this rural-urban differential in Liberia's fertility. Regional fertility differential was significantly for only 2013LDHS. Using South-Central (includes Montserrado, the capital region of Liberia) as the base region, in 2013, women from all other regions have a significantly higher number of CEB on average than women from the South-Central region. In 2007, only women from South-Western B had significantly higher fertility than women from South-Central region.

Also, having more child deaths increases the number of CEB. The death of a child increases the number of CEB by a little more than 10% for all the three waves. This corroborates the positive child deaths-fertility relationship Agyei-Mensah & Owoo (2015) and Owoo et al. (2015) found in Ghana and Snopkowski et al. (2016) found in Matlab and San Borja. This is because the opportunity cost of childbearing and childrearing for women employed in the non-agricultural sector is higher compared to women who are not working (Beatty, 2015; Lan & Kuang, 2016). The result from this paper is consistent with the findings of Agyei-

Mensah & Owoo (2015) and Kollehlon (1984) on the fertility difference between women working in the non-agricultural sector and women who are not working.

Table 5.2: Poisson regression of fertility on wife's education, husband's education, contraceptive usage, desired fertility and a set of control variables.

VARIABLES	1986LDHS	2007LDHS	2013LDHS
Wife's Education (base category is 'no education')			
Primary	0.0601**	0.00234	-0.0210
	(0.0297)	(0.0176)	(0.0138)
Secondary and Beyond	-0.0297	-0.135***	-0.156***
	(0.0347)	(0.0216)	(0.0194)
Husband's/Partner's Education (base category is 'no education')			
Primary	0.132***	0.00572	0.0226
	(0.0353)	(0.0233)	(0.0169)
Secondary and Beyond	0.0775***	0.0245	-0.0342**
	(0.0226)	(0.0185)	(0.0155)
Contraceptive Usage (base group is 'uses no method')			
Using Modern Method	0.0732**	0.102***	0.128***
	(0.0302)	(0.0207)	(0.0147)
Using Traditional Method	0.0205	-0.0338	0.146**
	(0.0539)	(0.0483)	(0.0700)
Desired Fertility (ideal number of children)	0.0153***	0.0256***	0.0272***
	(0.00313)	(0.00387)	(0.00240)
Age	0.183***	0.175***	0.168***
	(0.0100)	(0.00662)	(0.00667)
Age Square	-0.00208***	-0.00193***	-0.00183***
	(0.000155)	(9.56e-05)	(9.46e-05)
Age at First Birth	-0.0436***	-0.0408***	-0.0388***
	(0.00291)	(0.00227)	(0.00190)
Age at First Sex/Intercourse	-0.0101	-0.000890	-0.00183
	(0.00671)	(0.00356)	(0.00301)
Child Deaths	0.122***	0.108***	0.112***
	(0.00738)	(0.00685)	(0.00524)
Rural-Urban Residence (base category is 'rural')	0.0345	-0.0765***	-0.0681***
	(0.0270)	(0.0191)	(0.0145)
Religion (base category is 'Christian')			
Muslim	0.0112	0.00699	0.0117
	(0.0392)	(0.0290)	(0.0209)
Others (including Traditional)	-0.00584	-0.0249	0.0111
	(0.0242)	(0.0296)	(0.0341)
Ethnic Group (base category is 'Other Tribes')			
Kru Tribes	0.102	0.0216	0.0412
	(0.0656)	(0.0428)	(0.0440)
Mande-Fu Tribes	0.125*	0.00988	-0.0217
	(0.0680)	(0.0424)	(0.0433)
Mande-Ta Tribes	0.0757	0.0547	-0.0296
	(0.0830)	(0.0518)	(0.0407)
Mel Tribes	0.102	0.0482	-0.00897
	(0.0714)	(0.0475)	(0.0490)
County/Region (base category is 'South Central')			
North-Western	0.00117	0.00682	0.0742***
	(0.0461)	(0.0331)	(0.0197)
North-Central	-0.00425	0.0273	0.0670***

	(0.0271)	(0.0227)	(0.0152)
South-Eastern A	0.00884	0.0313	0.0467**
	(0.0355)	(0.0275)	(0.0212)
South-Eastern B	0.0475	0.0796***	0.0875***
	(0.0377)	(0.0236)	(0.0186)
Occupation (base category is 'Not Working')			
Agricultural		-0.00619	0.0176
		(0.0194)	(0.0132)
Non-Agricultural		-0.0434**	-0.0329*
		(0.0177)	(0.0169)
Household Wealth (base category is 'Low-Wealth)			
Middle	-0.0106	0.00837	-0.0343**
	(0.0258)	(0.0137)	(0.0162)
High	0.0596*	-0.0618**	0.00321
	(0.0339)	(0.0243)	(0.0140)
Constant	-1.682***	-1.680***	-1.567***
	(0.192)	(0.123)	(0.108)
Observations	2,206	4,324	6,065

*Standard errors in parentheses [*** p<0.01, ** p<0.05, * p<0.1]*

Additionally, in 1986, women from high-income households had significantly a greater number of CEB than women from low-income households. This is similar to the finding from the Navrongo research (Debpuur et al., 2002). In 2007, the difference between women from high-income household and low-income households changed to positive. The finding here may be as a result of parents in high-income household see the need to invest more in the quality of their children through increased education and training (Agyei-Mensah & Owoo, 2015). On the other hand, the fertility difference between women from middle-income households and low-income was only significant for 2013. Using women who were not working as the reference occupation, women who were engaged in non-agricultural jobs have fewer CEB than women who were not working.

5.3.2. Structural Equation Model

The objective of this section is to determine whether wife's education is fully or partially mediated by contraceptive usage and knowledge and desired fertility. Thus, whether wife's education has only a direct effect, only an indirect effect or both direct and indirect effect on fertility. Except for contraceptive knowledge and usage, all other variables used in this

section are continuous. Wife's education is the independent variable, fertility (number of CEB) is the dependent variable while desired fertility, contraceptive usage and contraceptive knowledge are the mediating variables. While fertility, desired fertility contraceptive knowledge and contraceptive usage remained as presented in the summary statistics, education in single years was used as the measure of education for the wife. The average years of education for women have increased from 2.59 years in 1986 to 4.48 years in 2013.

Also, for one to perceive the existence of a mediating effect between two variables, there should be the existence of three relationships. First, the independent variable (in this case wife's education) should significantly predict the dependent variable (fertility). Second, the independent variable should significantly predict the hypothesize mediating variable(s) (contraceptive knowledge and usage and desired fertility in this case). Third, the inclusion of any of the hypothesized mediating variables in a regression analysis should either change the size and/or the significance of the coefficient of the independent variable.

The first step in this mediating analysis was to check if wife's education significantly predicts fertility (dependent variable) and desired fertility, contraceptive usage, and contraceptive knowledge (mediating variables). From the results presented in Table 5.2, wife's education significantly predicts both the dependent variable and the mediating variables.

The third relationship check was conducted and the addition of any of the hypothesized mediating variables led to either an increase or a decrease in the size of the coefficient for wife's education. The significance of wife's education remains the same as presented in Table 5.3. Also, contraceptive knowledge was not included in this check because knowledge without the necessary action cannot lead to a change. To be sure whether contraceptive knowledge, as well as any of the other mediating variables, mediates the effect of wife's

education on contraceptive usage, a similar check for the third relationship was conducted for contraceptive usage.

The result from STATA did not allow for the conclusion of whether the third relationship has been satisfied for contraceptive knowledge. The results showed that desired fertility may mediate the effect of wife's education on contraceptive usage. Given possible three mediating variables and the complex relationship between wife's education and fertility and some of the mediating variables, it will be impossible to determine an indirect effect from a single estimation that includes all the three mediating variables.

Table 5.3: Regressing Fertility, Desired Fertility, Contraceptive Usage and Contraceptive Knowledge on Wife's Education

	Dependent Variables				
	Fertility	**Desired Fertility**	**Contraceptive Knowledge**	**Contraceptive Usage** *Modern Method*	*Traditional Method*
1986LDHS					
Wife's Education	-0.0521*** (0.00448)	-0.0423*** (0.00211)	0.256*** (0.0187)	0.246*** (0.0187)	0.289*** (0.0339)
Constant	1.251*** (0.0196)	1.901*** (0.0148)	0.496*** (0.0792)	-3.669*** (0.118)	-5.597*** (0.278)
2007LDHS					
Wife's Education	-0.0702*** (0.00348)	-0.0328*** (0.00167)	0.234*** (0.0215)	0.140*** (0.0130)	0.203*** (0.0229)
Constant	1.343*** (0.0165)	1.722*** (0.0140)	1.323*** (0.135)	-2.627*** (0.102)	-5.054*** (0.213)
2013LDHS					
Wife's Education	-0.0818*** (0.00336)	-0.0346*** (0.00156)	0.198*** (0.0254)	0.0824*** (0.00955)	0.160*** (0.0485)
Constant	1.363*** (0.0195)	1.723*** (0.0117)	3.401*** (0.126)	-1.745*** (0.0619)	-5.098*** (0.572)

*Standard errors in parentheses [*** p<0.01, ** p<0.05, * p<0.1]*

A structural equation model was then fitted using a SEM builder in STATA. The estimation of the model considered the survey sampling technique used by the DHS, the weight and missing values in the data. The coefficients presented are standardized coefficients as it allows for comparison between variables if the need be. Mediating variables that reduce the magnitude of the coefficient of the independent variable are positive mediating variables whereas mediating variables that increase the magnitude of the coefficient of the

independent variable are negative mediating variables. Below are the channels through which wife's education is expected to affect fertility.

1. $Wife's\ Education \underset{(-)}{\longrightarrow} Fertility$
2. $Wife's\ Education \underset{(+)}{\longrightarrow} Husband's\ Education \underset{(+)}{\longrightarrow} Contraceptive\ Knowledge \underset{(+)}{\longrightarrow} Contraceptive\ Usage \underset{(-)}{\longrightarrow} Fertility$
3. $Wife's\ Education \underset{(-)}{\longrightarrow} Desired\ Fertility \underset{(+)}{\longrightarrow} Fertility$
4. $Wife's\ Education \underset{(-)}{\longrightarrow} Desired\ Fertility \underset{(-)}{\longrightarrow} Contraceptive\ Usage \underset{(-)}{\longrightarrow} Fertility$
5. $Wife's\ Education \underset{(+)}{\longrightarrow} Contraceptive\ Knowledge \underset{(+)}{\longrightarrow} Contraceptive\ Usage \underset{(+)}{\longrightarrow} Fertility$
6. $Wife's\ Education \underset{(+)}{\longrightarrow} Contraceptive\ Usage \underset{(-)}{\longrightarrow} Fertility$

Table 5.4 presents the results of the SEM analyses. The plan was to remove all paths that were not statistically significant in the initial model as presented in the methodology. Thus, once wife's education does not have a significant effect (either direct or indirect) on any of the mediating variables, is supposed to be removed from the model.

Table 5.4: Analysis of the effect of wife's education on fertility using SEM

	Only Education	Inclusion of Desired Fertility	Inclusion of Contraception	Inclusion of both Mediators
1986LDHS				
Education	-0.151***	-0.165***	-0.181***	-0.177***
	(0.0116)	(0.0118)	(0.0125)	(0.0126)
Desired Fertility		1.684***		1.653***
		(0.0667)		(0.0680)
Contraceptive Usage			1.011***	0.336**
			(0.149)	(0.160)
Constant	3.509***	2.942***	3.489***	2.946***
	(0.0686)	(0.0666)	(0.0678)	(0.0666)
Observations	5,239	5,239	5,239	5,239
2007LDHS				
Education	-0.202***	-0.151***	-0.209***	-0.157***
	(0.00962)	(0.00993)	(0.0103)	(0.0104)
Desired Fertility		1.382***		1.380***
		(0.0527)		(0.0526)
Contraceptive Usage			0.311***	0.265***
			(0.109)	(0.0916)
Constant	3.828***	2.732***	3.807***	2.716***
	(0.0617)	(0.0761)	(0.0608)	(0.0754)
Observations	7,092	7,092	7,092	7,092
2013LDHS				
Education	-0.224***	-0.163***	-0.230***	-0.168***
	(0.00831)	(0.00682)	(0.00825)	(0.00678)
Desired Fertility		1.573***		1.571***
		(0.0430)		(0.0432)

Contraceptive Usage			0.344***	0.305***
			(0.0834)	(0.0700)
Constant	3.890***	2.722***	3.838***	2.678***
	(0.0707)	(0.0625)	(0.0747)	(0.0642)
Observations	9,239	9,239	9,239	9,239

*Standard errors in parentheses [*** p<0.01, ** p<0.05, * p<0.1]*

Also, if any of the mediating variables does not have a significant effect (either direct or indirect) on fertility, it was to be removed from the model. In all three waves, all the paths proved to be significant and so none was deleted from the model.

In all the three waves, wife's education has a negative effect on fertility whether wife's education is the only variable in the model or when the mediators are included in the model. The addition of desired fertility causes the size of the coefficient of wife's education to reduce while the addition of contraception causes the size of the coefficient of wife's education to increase. This agrees with the findings of Basu, (2002) and Kim, (2016) on the existence of both negative and positive mediating variables to the fore. In the case of Liberia, from Table 5.4, desired fertility causes education to have a positive indirect effect on fertility whereas contraception (thus, both knowledge and usage) causes wife's education to have a negative indirect effect on fertility. The negative indirect effect of wife's education in 2007LDHS and 2013LDHS was the result of the negative indirect effect caused by contraception outweighing the positive indirect effect caused by desired fertility. Thus, while contraception increases the negative effect of education, desired fertility decreases the negative effect of education.

In all waves, wife's education has both direct and indirect effect on fertility as presented in Table 5.5, implying a partial mediation of education's effect on fertility by other variables. The direct effect is negative and statistically significant for all the three waves while the indirect effect, except for 1986LDHS, is also negative and statistically significant. For all the three waves, the effect of education is partially mediated by desired fertility,

contraceptive knowledge and contraceptive usage, but the proportion of education's effect being mediated is less than the direct effect education has on fertility. From this SEM analysis, there appears to more temporal similarities and a little temporal differential in the mechanism through education affect fertility in Liberia.

Table 5.5: Direct, Indirect and Total Effect of Wife's Education on Fertility

	Direct Effect	Indirect Effect	Total Effect
1986LDHS	-0.177***	0.027***	-0.151***
	(0.012)	(0.005)	(0.012)
2007LDHS	-0.157***	-0.045***	-0.202***
	(0.010)	(0.006)	(0.010)
2013LDHS	-0.168***	-0.056***	-0.224***
	(0.008)	(0.005)	(0.008)

*Standard errors in parentheses [*** p<0.01, ** p<0.05, * p<0.1]*

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Summary

This thesis aimed at investigating the roles education, contraception and desired fertility have played on the fertility of Liberia women. In doing so, four questions were asked. The first three questions w addressed using a Poisson regression analysis while the fourth question was investigated using the structural equation model (SEM).

First, whose education is significant in reducing fertility in Liberia, husband's or wife's? The findings of this study found husband's education than wife's education to be significant in explaining fertility in 1986 while in 2007 and 2013 wife's education than husband's education was found to be more significant in explaining fertility. For wife's education, there was an increasingly negative effect for the levels of education that have a negative effect on fertility. For both wife's and husband's education, there was a decreasing positive effect for the education levels that have a positive effect on fertility while some of those that have positive effect turned negative. Also, secondary education and beyond, significant or insignificant, has a negative effect on fertility for wives. This study also found out that the level of wife's education required for a significant drop in fertility has moved from no level of education been significant in 1986 to secondary education and beyond in 2007 and 2013. In addition, the fertility reducing effect of wife's education has increased. This study agrees with the literature that believes the effect of education to be increasingly significant as the proportion of women with education increases (Kim, 2016; Martin, 1995; Murthi, 2002). Husband's education, on the other hand, was among the variables that explained Liberia's fertility in 1986 and 2013 waves.

Whether or not contraceptive usage has been a significant player in reducing fertility was the second question of this study. This study found the usage of modern contraceptive to

have a significant positive effect on fertility for all the three waves. This led to the conclusion that, demand for modern contraceptives was for the purpose of spacing instead of limiting childbirth (Agyei-Mensah & Owoo, 2015; Snopkowski et al., 2016) or possibly its likely to be used to prevent the disruption of education or other engagements (Parr, 1995). On the other hand, the usage of a traditional method of contraceptives had a significant positive effect on fertility in 2013.

The third question was to investigate whether women with higher ideal family size have higher fertility. From this study, women with high desired fertility (ideal number of children) have significantly higher fertility (number of CEB).

Other variables that explain the fertility of Liberia for all the three waves are the age of a woman, age at first birth, child deaths and household wealth as proxied by household ownership of assets. Urban residence, region, and employment have also helped in explaining fertility in 2007 and 2013.

The last question asked whether the effect of education on fertility was fully or partially mediated by other variables. In other words, does education has only a direct effect, only indirect effect or both direct and indirect effects on fertility? In answering this question, the SEM analysis was employed. Education was found to have both direct effect and indirect effect on fertility. Thus, education was partially mediated by other variables. The direct effect was greater than the indirect effect. In 1986, the indirect effect of education was positive, whereas in 2007 and 2013, the indirect effect of education was negative. Also, whereas desired fertility had a positive mediating effect, contraception had a negative mediating effect.

6.2. Conclusion

Education, contraception and desired fertility have contributed significantly to fertility in Liberia. Wife's education has had an increasingly negative significant effect on fertility, whereas contraception has had a significant positive effect on fertility. Whilst no level of education was significant in reducing fertility in 1986, secondary education and beyond was required in reducing fertility in 2007 and 2013. Women who have high desired fertility had significantly higher fertility. The question about the role of these variables during the period of civil war is still not answered. More information, especially during this period, is required for a proper diagnosis to ascertain what prevented the civil war from having its full impact on fertility. Lastly, wife's education has both a direct and an indirect effect on fertility, but only a smaller portion of education's effect on fertility is being mediated by other variables.

6.3. Policy Recommendations

According to the findings from 2013LDHS data, women with primary education and secondary education and beyond have 1.09% and 17.2% respectively less of CEB compared to women with no education but is only for secondary education and beyond where educational fertility differences are significant. Free compulsory education in Liberia according to their Education Law of 2001 is up to the completion of a six-year primary school. While this may have a negative effect on fertility, the effect is not significant. For women's education to have a significant effect on fertility, the government should expand the free compulsory education to at least secondary education. Also, the Partnership Schools Liberia (PSL) which was launched in 2016, a public-private partnership (PPP) between the Liberian government and Bridge as well as other education service providers that have to a larger extent been able to achieve its object of improving children's learning outcomes dramatically, should be extended beyond primary level. Not just extending it beyond

secondary level, but if the government and the partnering private institution can increase the pace of growth of the initiative to cover all parts of the country, primary education alone may have a significant negative effect on fertility (Kim, 2016; Martin, 1995; Murthi, 2002). In addition, extending the program beyond primary level will allow for lessons on family planning and contraception to be taught in classrooms. This may lead usage of contraception to have a negative effect on fertility.

Also, the positive relationship between contraceptive usage and fertility calls for policymakers in Liberia to evaluate whether family planning programs, as well as contraceptive programs, have achieved the targets and intended purposes. Also, as recommended by Nichols et al. (1987), lessons on family planning and contraceptives should be included in the secondary school curriculum.

Again, there is the need for government to restore the link between education and employment because if the link between education and employment is restored, people of school-going age will be motivated to complete higher levels of education. This in itself alone will lead to a decrease in fertility. If policymakers and implementers will be able to restore this link, education may have a negative indirect effect on fertility through employment (Becker & Lewis, 1973; as cited in Ahene-Codjoe, 2007).

6.4. Recommendations for Further Studies

A moderation analysis on contraception and desired fertility effect on fertility is required. This will help policy maker to know whether education can be used as a catalyst to increase the usage of contraceptives or whether education lowers the ideal family size of the Liberian people.

A more in-depth analysis needed to ascertain the positive relationship between the contraceptive usage and fertility that exit in Liberia. This will go a long way to inform policymakers on the areas where there is an unmet need for contraception and family planning programs. This will also shed light on which of their interventions that have by far made the greatest impact.

Also, as indicated earlier in the methodology the SEM analysis does not allow for the control of the nature of variables, so a GSEM analysis which allows for nature of variables to be controlled for is required for further analysis. Though this may not provide the direct and indirect effects, will shed more light on the complexity of the relationship between education and fertility. Also, contraception and desired fertility are not the only variables that may mediate the effect of education on fertility. More empirical studies are required to aid researcher who may in future will want to apply GSEM on Liberia fertility data, to know the determinants of fertility which are affected by education. Since the SEM analysis was limited by the nature of the data used, the effect of education on contraception and desired fertility in Liberia requires further studies. Liberia has received little or no empirical works in these areas, a study in these directions will add to the reproductive and contraception literature of Liberia in particular and of SSA in general.

Most of the few empirical works done in Liberia are dated and so works on the effect of religion, ethnicity, county, employment among others using recent data are required. The ethnic and religious orientation of the women may have been the offsetting variables in the effect of civil war. Also, since Liberia has received little empirical in fertility studies, an indebt analysis on age, especially cohort analysis, among other variables will add a lot to the literature on Liberia.

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