KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

GHANA

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH

CONTEXTUAL VERSUS COMPOSITIONAL EFFECTS ON CUMULATIVE FERTILITY IN GHANA – A MULTILEVEL ANALYSIS

BY

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NOVEMBER, 2015

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A THESIS SUBMITTED TO THE DEPARTMENT OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH, COLLEGE OF HEALTH SCIENCES, SCHOOL OF PUBLIC HEALTH, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF PUBLIC HELATH IN POPULATION AND REPRODUCTIVE HEALTH

NOVEMBER, 2015

DECLARATION

The work described in this thesis was carried out at the Department of Population, Family and Reproductive Health, KNUST-School of Public Health. I declare that, except for references to other people's work, which I have duly acknowledged, this thesis is original to me. This work has not been submitted either completely or in part for the award of any other degree in this or any other university.

December 21 2015

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Oduro Oppong-Nkrumah Date

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Dr. Easmon Otupiri (Supervisor) Date

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Head of Department Date

DEDICATION

To my daughter Eno Akua.

ACKNOWLEDGEMENT

I would like to express my profound gratitude to the God for his grace and mercies. I am also deeply grateful to my academic advisors, Dr. Easmon Otupiri and Mr. Emmanuel Nakua for their support and guidance. I m also grateful to my family, especially my Dad Mr. Kofi Oppong-Nkrumah for his total and unwavering support in this endeavor.

ABSTRACT

Ghana has experienced an unexpectedly rapid fertility decline over the past 30 years, which has not been adequately explained in light of the concurrent persistently low usage of contraception. Factors at both the individual and contextual level have been investigated for their role in the determination of fertility levels and differentials in Ghana however, the relative contributions of the contextual factors compared with the individual factors to variation in fertility has rarely been studied. This study investigated how much of the observed district level fertility differentials are attributable to contextual versus compositional effects using a multilevel framework.

Data from the second round of the Performance Monitoring and Accountability 2020 survey were analyzed using a 2-level multilevel framework with individuals as the first level and districts at the second level. Age, education, wealth, marital status, history of family planning use and age at first sex were used as individual-level predictors while urban/rural residence was included as a district-level explanatory variable. Multilevel multivariate regression models with interaction terms included were used to determine how much of the variance was attributable to each level.

Age, education, marital status, age at first sex and history of family planning were found to significantly influence cumulative fertility, however, most of the observed effects of these variables were significantly attenuated when age interactions were included in the models. The models also found that only 3-4% of the variance in cumulative fertility could be attributed to contextual effects as opposed to individual effects.

Cumulative fertility is primarily determined by individual-level characteristics, and how these characteristics change with age and over time. Thus, policies aimed at fertility regulation should pay particular attention to improving the socio-economic circumstances of women.

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LIST OF ACRONYMS

CEW	Children Ever Born
CWR	Child Woman Ratio
CHPS	Community Health Planning and Services
GDHS	Ghana Demographic and Health Survey
GDP	Gross Domestic Product
HIV	Human Immunodeficiency Virus
KNUST	Kwame Nkrumah University of Science and Technology
OLS	Ordinary Least Squares Regression
PMA2020	Performance, Monitoring and Accountability 2020
TFR	Total Fertility Rate

CHAPTER 1: INTRODUCTION

This chapter introduces the basic concepts of fertility, and discusses the current levels and differentials in fertility in Ghana, and what is known about the factors that have contributed to the current state of affairs. It then identifies gaps in the current state of knowledge, which are summarized in the form of a problem statement. It goes on to provide justification for this study in terms of the potential usefulness of the study results. All this is put in the context of a conceptual framework that is derived from two current theories of fertility decline. Finally there is a short discussion of the scope of this study.

BACKGROUND

Fertility decline is one of the main aims of Ghana's National Population Policy of 1994. This policy recognizes *"…the crucial importance of a wide understanding of the deleterious effects of unlimited population growth and the means by which couples can safely and effectively control their fertility,"* (National Population Council, 1994). It aims to reduce the total fertility rate to 4.0 by 2010 and to 3.0 by 2020; (Addo, 1987). Achieving sustainable fertility decline across the country requires a thorough understanding of the factors which influence fertility so that programs can be designed to modify these factors as needed to achieve the goal.

Ghana has achieved remarkable fertility decline in the past four decades. The total fertility rate of Ghana has fallen from the 6.47 recorded in the World Fertility Survey of 1979 (Cleland & Hobcraft, 1985; Cleland & Scott, 1987) to about 3.7 in 2013 (PMA2020, 2013). While varied reasons have been given for this dramatic decline (Benefo & Schultz, 1996; Bongaarts, 2006; Boserup, 1985; Bryant, 2007; John C. Caldwell, Orubuloye, & Caldwell, 1992), fertility transition experienced in Ghana has not conformed to established models. For example, despite the fact that increased contraceptive use is thought to be one of the major drivers of fertility decline across the world, the progress of fertility decline in Ghana has been achieved without a commensurate increase in the utilization of contraception (Benefo & Schultz, 1996; Blanc & Grey, 2002)

Researchers investigating the factors which influence fertility decline have to keep in mind the fact that the levels of aggregation at which they define their variables have an impact on the results they obtain (Bliese, 2000; Klein & Kozlowski, 2000)(Bollen & Van de Sompel, 2006) Population fertility levels result from the aggregation of the individual reproductive behaviors of the members of the population and thus, it would appear that variables used to predict fertility should be defined at the individual level. However, contextual factors such as social norms on marriage and contraception influence individual reproductive behavior. Policies and programs aimed at achieving fertility change are often designed and implemented at population level and these may influence individual reproductive behavior (Bongaarts, 1994; Pritchett, 1994). Thus, there is a strong argument to be made for the inclusion of aggregated and population-level variables in models of fertility (Lloyd & Gage-Brandon, 1994) (Bongaarts, 2001) (John C. Caldwell, 1979).

This interplay between contextual and individual level variables in the determination of reproductive behavior and fertility levels has been studied by a number of researchers including Zaba et al, who in 2004 observed that significant behavioral changes such as increasing age at first sex could be attributed to “tremendous socio-economic change resulting in increased levels of education, wealth accompanied by significant urbanization” and that these were ultimately responsible for the observed decline in fertility in Ghana. (Zaba, Pisani, Slaymaker, & Boerma, 2004) The determinants of fertility interact with each other not just within, but also across levels. The complexity of some of these interactions is illustrated by the interaction between education and urban/rural residence in their effect on fertility. While urban fertility has been consistently found to be lower than rural fertility

(Muhuri, 1994) (Mboup, 1998) (Lee, 1993) (Alene, 2008), urban/rural residence is also known to be associated with higher levels of education and literacy (including girl child education) (Zhang, 2006) (Kravdal, 2002), which are also linked in turn to higher levels of income and wealth (Barrett, Reardon, & Webb, 2001) (Sahn & Stifel, 2003) higher usage of contraception, and lower levels of unmet need for contraception (Khan, Mishra, Arnold, & Abderrahim, 2007) (Adongo et al., 1997) (Ainsworth, Beegle, & Nyamete, 1996)). The extent to which the observed urban-rural differentials in fertility are due to differentials in education levels between urban and rural folk, as opposed to differential distributions of the determinants of fertility in the urban-rural space has been less studied and is not clear. Considering the complexity of the determination of fertility, the population policy of Ghana would appear to be right in its broad based approach to fertility decline.

PROBLEM STATEMENT

Several explanations have been proffered for the decline in fertility observed in Ghana over the past three decades (John C. Caldwell et al., 1992; Chuks, 2002; Shapiro & Gebreselassie, 2009). In order to understand the roles played by the various factors influencing fertility in Ghana, it is imperative to know how they interact to produce changes in fertility. The interaction of these variables is often complicated due to the fact that they operate at different levels of aggregation. While individual and household fertility are most directly influenced by individual and household characteristics such as education, wealth and marital status, these are further influenced by factors which act at the higher levels such as the status of women in the community and prevalent cultural norms among others (Muhuri, 1994; Baffour Kwaku Takyi, 1993).

This hierarchical relationship between the factors influencing fertility needs to be accounted for in the analysis of fertility phenomena if accurate estimations of effect are to be made (Kaufman, Alonso, & Pino, 2008; Snijders, 2011). However, few studies of fertility in

Ghana have accounted for this hierarchical determinant structure. Previous approaches have either aggregated the factors at the group level or treated group level factors as individual level variables. Neither of these approaches is satisfactory as they lead to loss of information and biased estimates (Kaufman, 2008).

Related to this issue is the question of how much of the observed effect of fertility is due to contextual effects such as the general level of socio-economic development in a district (sub-national level) as opposed to the composition of individual-level characteristics in the district. For example, is the lower level of fertility observed in an urban district such as the city of Accra due to the district-wide availability of contraceptives (or other district-level variables), or due to the fact that this urban area has a higher proportion of highly educated women who are known to have generally lower levels of fertility?

Figure 1.1 below illustrates how factors at different levels interact to influence fertility levels. In this specific case, we see that changes in contextual-level factors such as the socio-economic characteristics of women (including education, employment and poverty), and changes in reproductive health services (such as access to family planning) interact to jointly influence intermediate factors (changes in reproductive behavior) to produce changes in fertility levels. This framework in particular, seems to assume that the mediating factors have no independent effect of their own on changing fertility. Other models focus on individual level factors as the direct determinants of fertility response and pay little attention to contextual factors, which are deemed to have no direct effects on fertility change. Which of these approaches is right? Does the truth perhaps lie somewhere in between these two forms?

This study attempts to answer these questions by reexamining some of the known determinants of fertility in Ghana, accounting for individual and district level factors, with a view to determining the relative contributions of contextual factors (district-level, urban/rural residence) and compositional factors (the relative prevalence of different individual level characteristics) to cumulative fertility in Ghana.

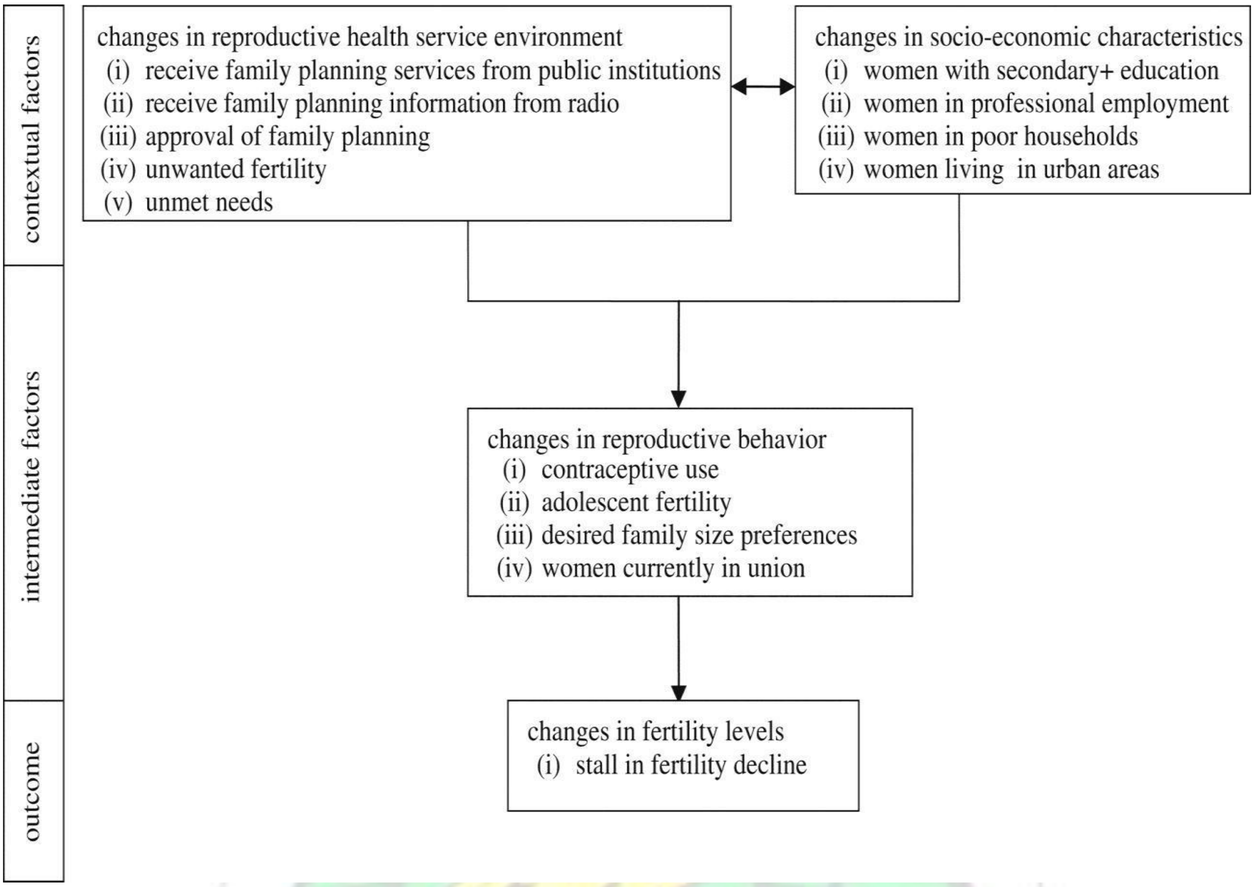


Figure 1-1 Determinants of Fertility

Source: Ezeh et al. 2009

RATIONALE FOR THE STUDY

The utility of this study derives from the fact that it disaggregates the determinants of cumulative fertility at the district level into contextual and compositional components and combines them in a single hierarchical model. This approach offers several distinct advantages, which allow the application of the study findings in diverse fields. By estimating the relative contributions of contextual and compositional effects to fertility, this study will provide a deeper understanding of how these factors act and interact to produce their final effects on fertility. This knowledge is important for the refinement of current models of fertility and the development of new ones.

Further, the findings of this study will aid policy development by identifying high leverage points at the individual or contextual level which could achieve the greatest possible effect as well as improving the efficiency of resource deployment for both new and existing programs.

In addition, this study will introduce the application of multilevel methods to the study of demographic phenomena and thus hopefully spur further application of these concepts in future studies.

CONCEPTUAL FRAMEWORK

This framework gives a foundation for the hierarchical analysis of fertility determinants that is done in this study. The conceptual framework for this study is based on two theoretical frameworks, which explain the motivational and ideational aspects of the fertility transition using rational factors (supply-demand) and socio-cultural influences (innovation/diffusion). From these, a model is developed which explains the relative influences of contextual and individual-level factors on fertility.

Supply and demand framework

The supply-demand framework views children as economic quantities (commodities) whose demand is subject to regulation by people’s rational actions. This framework suggests that the reproductive behavior of individuals is the result of reasoned calculations of costs and benefits of having extra children. It has its basis in neo-classical economics and has been championed by such notable economists as Richard Easterlin (Bongaarts, 1993; Easterlin, 1975)

In this framework, the potential supply of children is thought to be governed by exogenous factors (fecundity, mortality) that are essentially beyond the control of the individual while the demand for children is determined by a couple's fertility preferences. Couples attempt to balance the supply and demand for children by adopting various methods of fertility regulation such as prolonged abstinence and contraception (Easterlin & Crimmins, 1985).

Central to the determination of the demand for children is the idea of the "opportunity cost of children" first proposed by Nobel Prize-winning economist Gary Becker. Raising an extra child to adulthood requires the commitment of considerable resources by parents– resources that could have been used to provide an enhanced quality of life for the existing household (including the current living children). Thus, the demand for children, as expressed by the couple's ideal number of children is dependent on the resources available to the couple. (Robinson, 1997)

Resources in this regard refer not just to financial and other material resources, but also to time. The consideration of time in the determination of the cost of having an extra child helps explain why fertility is generally lower in richer countries. The time-cost of raising children in these societies is much higher because of the higher opportunity costs involved – the time spent raising the children could be spent earning more money or generally being more economically productive. Also, there is little demand for children to provide manual labor as societies have evolved from labor-driven agrarian economies to technology-driven industrialized economies. In these modern societies, children are generally prevented from engaging in economic activity to contribute to their upkeep until adulthood. In addition, couples have higher ambitions for their children and thus spend much more resources on preparing them for the future thereby further increasing the cost of having any extra children. Couples essentially faced with a trade-off between quantity and quality of children, choose to have fewer children and spend more to provide them with a higher quality of life (Bulatao & Lee, 1983; Gertler & Molyneaux, 1994; Hirschman, 1994; Rosenzweig & Schultz, 1985).

At the individual level, a woman's income, education, occupation and others. influence her demand for children, but these are in turn influenced by higher-level factors such as changes in technology, women's status in society, industrialization that affect the affordability and quality of care of children.

Innovation/diffusion framework

Some social scientists however disagree with the notion of human rationality, the keystone of neo-classical economics, as a driver of fertility behavior. One alternative mechanism, which has been proposed to explain fertility, is the diffusion of innovation. This is where a few influential early adopters of a new idea, are imitated by others leading to the spread of this idea. This is believed to have been the mechanism by which fertility limitation in marriage spread through Europe. Unlike with the supply/demand framework, the major driver of the spread of ideas is cultural rather than economic change. The practice of fertility limitation in Europe for example, spread across regions with similar sociocultural characteristics but very different economic circumstances, thus suggesting that the decline in fertility was induced through cultural change independent of the underlying economic structure. (Casterline, 2001; Wejnert, 2002)

As expected, the applicability of such a culture-specific framework is very context dependent. For example, more traditional societies, which hold strongly fatalistic, religious beliefs about fertility may not welcome innovations that may be deemed to usurp the role of the divine in the determination of levels of fertility. More "modern societies" in which individual freedoms and empowerment (especially of women) are celebrated tend to be more welcoming of such new ideas. (John C. Caldwell & Caldwell, 1987; McQuillan, 2004)

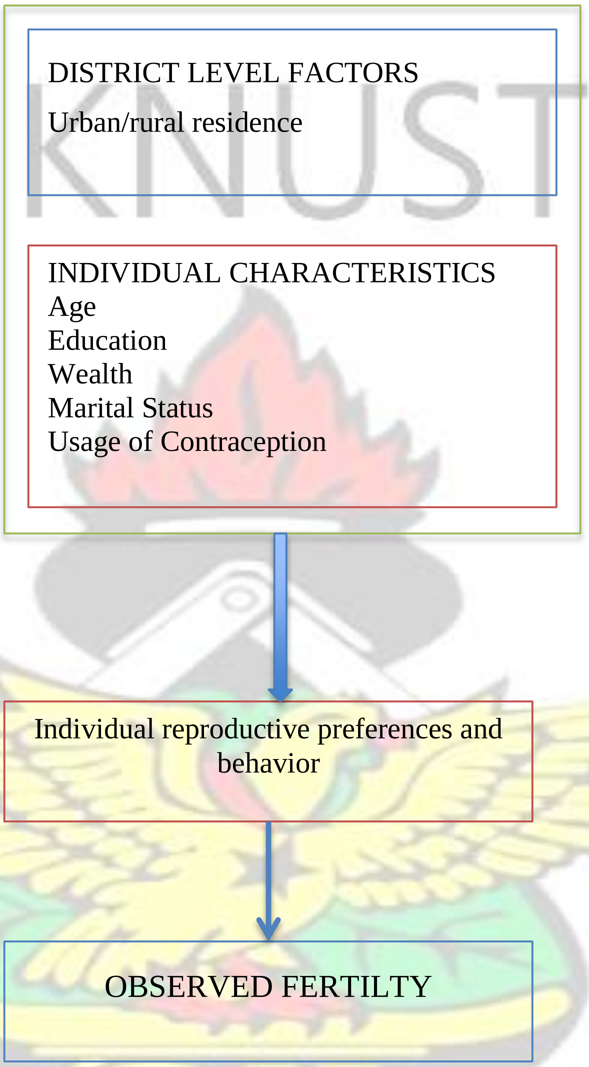
The supply-demand and innovation/diffusion perspectives are not mutually exclusive to each other. The ideational changes that are necessary for the diffusion of innovation are driven by the economic necessity while the spread of new ideas makes possible the kind of household level fertility regulation required to translate fertility preference into actuality.

Conceptual Framework for this Study

The conceptual foundation of this study is developed from an admixture of the core concepts in the above frameworks. It is premised on the idea that changes in fertility reflect the influence of factors that act at different levels, and that it is possible to parse out the relative contributions of the factors acting at these levels. Inasmuch it allows for interactions between these factors such as may occur when a person's education level is influenced by the overall quality of schools available in the community and the income levels of individuals affect the quality of schools available by affecting local tax revenues. It accepts the premise of the Supply-Demand framework that fertility preferences are driven by individual level considerations, which inform each person's decision-making, but also takes into consideration that the resulting fertility preferences must be realized through the application of ideas, which spread through a particular sociocultural context, by diffusion. It also incorporates the idea that individual level preferences are influenced in contextual factors and that, the spread of ideas from person to person eventually results in higher-level change.

For the sake of simplicity, this framework parses the effect of individual-level factors from the contextual-level factors and deals with their corresponding effects separately. The resulting model of fertility is thus able to separate the two effects and deal with them individually.

Figure 1-2 Conceptual Framework



Source: Author's construct, 2015

RESEARCH QUESTIONS

This study seeks to assess the relative contributions of contextual and compositional factors to district-level differentials in cumulative fertility. To answer this broader question, the following specific questions were answered:

1. What are the determinants of fertility in Ghana and how do they interact with each other?
2. How much of the variation in cumulative fertility is accounted for by individual level variables?
3. What is the contribution of contextual factors to the variation in cumulative fertility at the district level?

AIMS, OBJECTIVES AND HYPOTHESES

This study aimed to determine the relative contribution of individual level and district level characteristics to the variation in fertility at the district level across Ghana.

Specifically, this study sought to:

1. Assess the levels of cumulative fertility in Ghana.
2. Determine how cumulative fertility varies by socio-economic characteristics and by residence.
3. Examine the determinants of cumulative fertility in Ghana, and how they contribute to cumulative fertility
4. Ascertain the contribution of urban/rural residence and other district level factors versus individual level factors to cumulative fertility

FERTILITY AND HEALTH PROFILE OF GHANA

Geo-political characteristics

Ghana is located in West Africa between Burkina Faso in the North, Togo in the east, the Ivory Coast in the West and the Gulf of Guinea in the South. It extends from latitude 4^0 and 12^0 N and 4^0W and 2^0E, a total area of almost 240,000 square kilometers. Ghana is a tropical country with two main seasons–wet and dry. Its vegetation is predominantly grasslands (savannah) in the northern half, a mix of deciduous and rain forests in the middle belt, and costal scrublands in the coastal region. Ghana has a mix of plains, low hills and rivers and part of the Akuapem-Togo mountain range including its highest peak, Mountain Afadjato. It has the world's largest artificial lake (Lake Volta) on which are built the country's two largest dams generating hydroelectric power, the Akosombo and Kpong dams, which provide over half of the energy requirements of the country. (Kwamina & Benneh, 1977; Obeng, 1977; Petr, 1986)

Ghana currently has a population estimated at over 26 million with a growth rate of 2.1%. The population is currently over 50% urban and this is expected to grow to over 60% over the next decade. The country is very diverse ethnically and linguistically with over a 100 different language and cultural groups identified. The predominant language groups are the Akan, Ewe, Guan, Mole-Dagbane and Ga-Adangbe, each of which has several subgroups and dialects (Kropp, 2013). Most Ghanaians self-identify as religious–over twothirds profess Christianity while about 18% are Muslim. Several denominations of Christianity are active in the country with the majority being of the Pentecostal/Charismatic tradition. The Catholic Church remains the single most numerous denomination capturing about 13% of the population. Just over 5% of the population follows a form of Traditional African Religion while another 5% profess no religion. Religion plays a significant role in the social fabric of most communities, as many religious organizations are active in the provision of social services such as health and education especially in the rural areas of the country. (Ghana Statistical Service, 2012)

Ghana is a stable democracy with a centralized unitary presidential system of government. There are two main political parties, the social democratic National Democratic Congress and the liberal New Patriotic Party as well as several smaller parties. Ghana has a very active civil society and has been praised for having very active, free and independent media. Ghana is divided into 10 administrative regions with 145 districts. Ghana retains a form of traditional administration headed by traditional rulers (Chiefs) though they have limited power. While these traditional rulers are

constitutionally barred from participating actively in politics, they play an advisory role to the central government through the National House Of Chiefs and the Council Of State (Gyimah-Boadi, 2009; Koranteng & Larbi, 2008)

Health System

The health system of Ghana is largely government owned and ran. The public sector is the major provider of health services in Ghana with the main agency responsible for delivery healthcare being the Ghana Health Service. Another important quasigovernmental player, which is especially active in the rural areas of Ghana, is the Christian Health Association of Ghana, an umbrella body for the majority of the faithbased healthcare providers in the country. While not directly government controlled, the members of this association receive government subsidies and the majority of their staff are paid using public funds. Private healthcare providers are also active, though mainly in the urban areas.

There are 4 levels of health care provision in Ghana. At the primary level, there are health centers, polyclinics and Community Health Planning and Services (CHPS) compounds.

The second level of organization is the district hospitals whiles regional hospitals form the third tier. There are 4 teaching hospitals, which are semi-autonomous. Ghana still suffers a shortage of trained health personnel. In 2010, there were 15 physicians and 93 nurses per 100000 persons though the distribution is uneven across the country. Urban areas have significantly better health provision than rural areas with most doctors and nurses concentrated there.

Ghana has a universal system of tax-financed social insurance under the National Health Insurance Scheme introduced in 2003. This provides coverage for most of the common diseases encountered in Ghana. Public health activities in are heavily donor dependent. Health expenditure accounted for about 5% of GDP. (Irene A. Agyepong, 1999; Irene Akua Agyepong & Adjei, 2008; J. B. Eastwood et al., 2005; Gilson & Mills, 1995; Lavy, Strauss, Thomas, & De Vreyer, 1996; Mock & Maier, 1997; Nyonator, AwoonorWilliams, Phillips, Jones, & Miller, 2005; Witter & Garshong, 2009; World Health, 2010)

Health Data

Life expectancy in Ghana is about 66 years for males and 67 years for females. Infectious diseases such as malaria are still the most important causes of morbidity and mortality in Ghana. The infant mortality rate in Ghana is currently about 52 per 1000 live births while the maternal mortality rate is about 380 per 100000 live births. The HIV prevalence in Ghana is about 1.5% among adults and there are about 230000 people living with HIV/AIDS. (De Onis, Onyango, Borghi, Garza, & Yang, 2006; Gss & Macro, 2009; Naudé, 2013; Salomon et al., 2013)

The Total Fertility Rate of Ghana according to the Ghana Demographic and Health Survey of 2008 was estimated to be about 4.1 down from 4.7 in 2003. This is in line with a trend of significant decline over the past 3 decades. There are significant urban-rural differentials as well as by socio-economic status. The contraceptive prevalence rate is estimated to be about 34%. (Ghana. Statistical, Noguchi Memorial Institute for Medical, & MEASURE/DHS, 2004; Gss & Macro, 2009)Abortion in Ghana is legal if performed by a qualified agent in approved settings for a restricted set of indications (rape, incest, defilement etc.). The prevalence of abortion in Ghana is difficult to estimate as most of them are performed clandestinely. There is significant societal approbation of abortion and this has made it difficult for women to access even the legal forms of abortion where indicated. (Morhee & Morhee, 2006; Sedgh, 2010)

SCOPE OF STUDY

This study focuses on the cumulative fertility–it does not deal with other aspects of fertility such as the rate of population growth or the total fertility rate. In its multilevel approach, it is restricted to two levels with district as the second level. It is possible to have more than 2 levels in the multilevel model (for example, individual-enumeration area-district-region) but this was beyond the scope of this study (Goldstein, 2011; Snijders, 2011). This study used data from a nationally representative survey and its findings may be seen as being applicable nationally. This study was restricted in its modeling to the effect of mainly socio-economic variables. It does not deal with the effects other socio-cultural variables such as ethnicity and religion on cumulative fertility.

In addition, this study is limited to a cross-sectional view of fertility in Ghana. It would have been instructive to investigate how the factors affecting fertility change over time. This would have been achieved by adding a temporal element to the study such as a timeseries analysis.

This study did not consider the contribution of spatial distribution to the determination of fertility. Increasingly, spatial methods are being applied in the analysis of demographic phenomena. The spatial distribution of outcomes and predictors can itself be a source of variation and a spatial analysis would have helped to account for that. (Guilmoto & Rajan, 2001)

CHAPTER 2: LITERATURE REVIEW

This chapter is presented in two parts. The first starts with an overview of the study's subject matter and moves on to examine the current state of knowledge on the determinants of cumulative fertility in Ghana. The second part of the review examined the current stable of multilevel analytical techniques with emphasis on those applied in this study. It is meant as a broad introduction to a field that is both deep and expanding. While by no means a comprehensive review, it is meant to give the reader enough theoretical basis to critically read and analyze this study.

FERTILITY

Fertility from the perspective of demographers refers to the number of births to women in a particular place over a period of time as opposed to its colloquial (and clinical) sense of the potential of a woman (or couple) to reproduce. Demographers refer to the latter as fecundity. The distinction between these definitions becomes important when one considers how it is measured. To demographers, the physiological ability to reproduce (fecundity) represents potential fertility and must be actualized before being counted as contributing to fertility. Thus, demographers and physiologists end up with completely different ways of representing fertility. (Preston, Heuveline, & Guillot, 2000; Wood, 1989)

Starting here, you should provide literature on the following to address your specific objectives:

Measures of fertility

Demographers measure fertility on the population level. Fertility is important as a driver of population growth and the manner in which it is measured is determined by which aspect of population growth is being measured. As with many other demographic phenomena, there are two broad categories of fertility measures: period and cohort measures. Period measures capture the fertility experience of a group of people living together at the same time within a particular time period (and thus of different ages) while the cohort measures aggregate the lifetime fertility experience of a group of people born at the same time. As can be expected, cohort measures of fertility are difficult to measure and in practice, synthetic cohort measures which are generated from cross-sectional or panel data, are often used. (Sattar)

Probably, the most commonly used measure of fertility is the Total Fertility Rate which is defined as the number of children a woman could expect to have if she goes through her entire reproductive life experiencing the prevalent age-specific fertility rates. While a good measure for comparison across populations, any predictions made based on it must necessarily assume that the populations in question are static in their age-specific fertility experiences over time, which is usually not the case. Its cohort measure counterpart is the Completed Fertility Rate defined as the number of children a woman of a particular cohort actually had at the end of her reproductive period. This measure, as expected captures the fertility experience of women after they have completed their fertility and is thus unsuitable for capturing current trends in fertility. It is however seldom used as it can only be measured retrospectively.

Like all other demographic statistics, the determination of fertility indices relies on having accurate, reliable data sources, which are often unavailable in developing country contexts like Ghana. The lack of such data for the computation of these measures means that sometimes, less informative measures such as the Crude Fertility Rate and the ChildWoman Ratio are used. (Campbell, 1983; Cooper, 1991; Imhoff & Keilman, 2000;

Norman B. Ryder, 1982; D. P. Smith, 1992)

Table 2-1 Differentials in fertility in Ghana

	Total Fertility	Percentage of women aged 15-49 currently pregnant	Mean number of children ever born to women aged 40-49
Residence			
Urban	3.1	6.3	4.3
Rural	4.9	8.3	5.9
Region			
Western	4.2	7.5	5.0
Central	5.4	7.8	5.5
Greater Accra	2.5	7.0	3.9
Volta	3.8	6.7	5.0
Eastern	3.6	5.3	4.7
Ashanti	3.6	7.6	5.1
Brong Ahafo	4.1	4.8	5.6
Northern	6.8	12.2	6.9
Upper East	4.1	6.9	5.6
Upper West	5.0	7.1	6.4
Education			
No education	6.0	9.0	6.2
Primary	4.9	7.4	5.6
Middle/JSS	3.5	7.4	4.5
Secondary +	2.1	4.9	3.0
Wealth Quintile			
Lowest	6.5	8.6	6.4
Second	4.9	9.1	5.9
Middle	4.0	7.1	5.4
Fourth	3.4	5.9	4.4
Highest	2.3	6.6	3.8
Total	4.0	7.3	5.2

Source: GSS/GHS/ICF Macro, 2009

Sources of Fertility Data in Ghana

Since Ghana, like many other underdeveloped countries, lacks a reliable and comprehensive vital registration system, it relies on periodic surveys for data on demographic indices including fertility (Mahapatra et al., 2007; Morris, Black, & Tomaskovic, 2003; Setel et al., 2005). Across sub-Saharan Africa, the first major source of fertility data was the World Fertility Survey of 1979/1980(Cleland & Scott, 1987;

Ravenholt). In recent times, the major source of data on fertility in Ghana has been the

Ghana Demographic and Health Surveys, which, carried out every 5 years, provides a good idea of fertility trends over time. (Westoff, Charles, & Bankole, 1999)Another good source of fertility in formation is the Ghana Population and Housing Census, which is done every 10 years(Ghana Statistical Service, 2012). In recent years, other surveys such as the recent PMA2020 survey rounds have contributed accurate, periodic data at shorter intervals for the computation of levels and trends of fertility in Ghana(PMA2020, 2013) . Of course, in combining or comparing the findings of these different surveys, we must take note of the differences in methodologies and analysis employed. Despite these differences, there is generally good agreement between the findings of these studies.

Determinants of fertility

Fertility in the demographic sense is as much of a social phenomenon as it is a biological one. The physiological reproductive process is only the realization of several social and behavioral processes including marriage, contraception, etc. (Okonofua, Harris, Odebiyi, Kane, & Snow, 1997; Wood, 1989). Davis and Blake did the definitive early work exploring the determinants of fertility in the 1950s. Their work identified a number of "intermediate variables"–exposure to intercourse, conception and progress through gestation to birth–as mediating the link between broader social-economic, cultural and political phenomena and observed fertility as illustrated below (Davis & Blake, 1956).

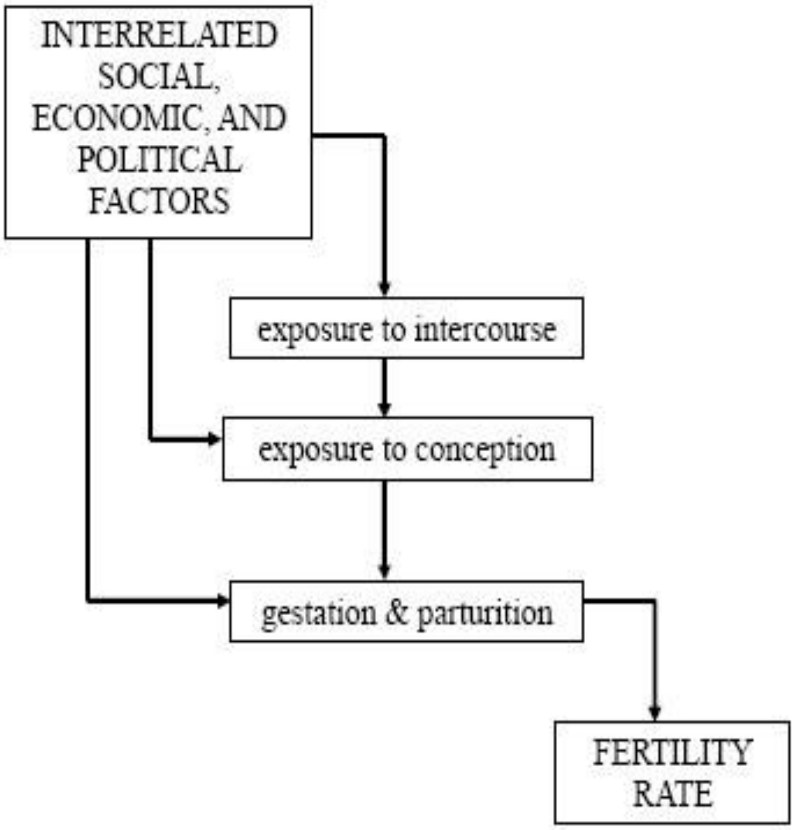


Figure 2-1 Contextual Factors Influencing Fertility Source:

Davis & Blake, 1956

The major thrust of their work was to link fertility with broader national developmental indices such as the Gross National Product. Their framework was derived from Modernization Theory, which was then the prevalent social theory(Bernstein, 1971; Tipps, 1973). They then went on to breakdown the factors, which affect each intermediate variable. For example, exposure to sex is influenced by the age at entry into sexual union, permanent celibacy, time spent between/after unions, abstinence (voluntary and involuntary) and coital frequency. In a similar vein, exposure to conception is modulated by voluntary and involuntary fecundity and the use of contraception while voluntary and involuntary fetal mortality have been identified as important factors influencing gestation and birth.

Interestingly, their models ignored breastfeeding as a factor in fertility modulation and also failed to quantify the factors they identified. (Davis & Blake, 1956)

Building up on the theories of Davis and Blake, Bongaarts et al, in the 1970s developed a model for predicting fertility, which attempted to quantify Davis and Blake's intermediate variables which they renamed the proximate determinants of fertility. Bongaarts and his colleagues developed a model using real-world data, which was able to assign relative importance to the proximate determinants based on how much of the variance in fertility they could explain. The result was a mathematical model of fertility predicting nationallevel fertility using an index of marriage (C_m), an index of contraception (C_e), an index of induced abortion (C_a), and an index of post-partum infecundability (C_i). The resulting model is expressed in the equation below. (Bongaarts, 1978)

$$TFR = C_m * C_e * C_i * C_a * TF$$

Both of these seminal works explored fertility at the national level. Hobcraft and Little went on to modify these models for application to individual level fertility. Their method of fertility exposure analysis provided a framework for quantifying the degree of effect of each of the proximate determinants on an individual's fertility and provided a framework for the development of regression models exploring the determinants of individual level fertility. (Hobcraft & Little, 1984)

Prior to these studies, researchers focused on exploring the effect of "upstream" socioeconomic and cultural factors on fertility. Many early works on fertility focused on the role of religion and other cultural factors in the determination of fertility. For example, Bumpass, in 1969, found that religion and having a farm background significantly affected fertility when Catholic and non-Catholic couples were compared. These effects were modified by literacy and women working away from the home. (Bumpass, 1969; Bumpass & Westoff, 1969)

Subsequent work has explored the role of other socio-economic factors on fertility using the Davis/Blake, or Bongaarts frameworks as a basis. In 1980, Rodriguez and Cleland, using data from 20 countries, found that rural-urban residence, education, employment status of both spouses and husband's occupation significantly affected fertility. They found that, those factors affecting the wife generally had a greater effect on fertility than those, which affected the husband. The actual relative effects of these variables differed from geopolitical region to region, perhaps reflecting the influence of unmeasured cultural factors. (Rodriguez & Cleland, 1980)

Other researchers have made similar findings. Singh and Casterline, in 1985, found from an analysis of data from developing countries in the world fertility survey that women's education affects fertility though not fertility preferences and that this effect is mediated by several factors. On one hand, education improves maternal and infant survival and health and thus tends to increase fertility while on the other; it lowers nuptiality by delaying marriage, thus decreasing it. They founds also that, rural residents consistently had higher fertility than their urban counterparts and they attributed these to differences in nuptiality and contraception though the relative importance of these effects varied by region. Across all regions, socio-economic status was found to affect fertility. (Singh & Casterline, 1985)

In 1984, Bongaarts et al, applied the proximate determinants framework to data on fertility in sub-Saharan Africa and concluded that, traditional child-spacing practices such as post-partum abstinence and prolonged breastfeeding were major contributors to fertility regulation in this region and that, the erosion of these practices combined with increases in fecundity due to improvements in healthcare were likely to prevent significant fertility decline in the region. Subsequent history has proved this to not be the case. (Bongaarts, Frank, & Lesthaeghe, 1984)

In the specific case of Ghana, an analysis of trends in the proximate determinants of fertility form 1988 to 1998 by Chuks found that postpartum infecundability was by far the most important factor explaining fertility–significantly more than contraception or marriage patterns. It also found a trend of increasing age at first marriage and age at first birth especially among the younger age groups in Ghana. That said, (Chuks, 2002)the
Ghana Demographic and Health Survey has consistently found differentials in the Total Fertility Rate in Ghana by education, wealth, and residence.

CUMULATIVE FERTILITY

Cumulative fertility refers to the number of children a woman born in a particular year or having certain characteristics would have delivered by a certain age. This is in effect a cohort measure of fertility. Cohort measures of fertility measure the fertility of a specific cohort of women as defined by birth (usually), some event (such as the introduction of family planning to a community), etc. As such, cohorts are often defined in terms of age. They have the advantage that they measure each individual woman's actually fertility experience rather than what they would be projected to experience given the crosssectional fertility data at a point in time. The use of cumulative fertility offers another way to incorporate cohort effects into cross-sectional estimates of fertility. As estimated by the Children-Ever-Born measure, cumulative fertility allows each woman's fertility to subsume the fertility influences of her particular cohort. Cohort measures of fertility have a number of advantages over their period counterparts. Perhaps the most important one is that they do not have to assume that socio-economic factors do not change in the future. Another key advantage they possess is that they are not subject to what have been referred to as tempo effects which occur due to a lag in the response time of period fertility measures to changing conditions. This is because of the dilution of period measures by those cohorts, which would not have been influenced, by these measures but which contribute to the period measures anyway. (Norman B Ryder, 1983) (Bhrolchain, 1992)

On the other hand, cohort measures suffer from being future-oriented and thus impossible to calculate for any age until the cohort in question reaches that age. Often, by the time the cohort measures can be estimated for a particular age, the socio-economic factors that might have influenced those measures no longer apply. For example, to estimate cumulative fertility at age 40 for a cohort born in 1980, one must wait till 2020 to be able to gather the required data, which is of course inconvenient. A middle approach which attempts to confer some of the advantages of the cohort approach to the estimation of period measures involves introducing cohort variables as covariates in the analysis and thus decomposing age and period effects in the factors influencing fertility. (Van Imhoff, 2001)

Cumulative fertility differentials by socio-economic characteristics and by residence

Several studies which have looked at the effect of socio-economic characteristics and residence on cumulative fertility (and other cohort measures of fertility have found that their relationships follow patterns akin to those that pertain to period measures of fertility.

An event-history analysis of urbanization and fertility by White et al in 2008 showed that cohort differentials in fertility are patterned similarly to those pertaining to their period counterparts. They found urban cohort fertility rates to be 11% lower than those for rural dwellers. In addition, socio-economic status (as measured by a possessions index) was found to influence fertility. As expected, cumulative fertility rates decreased with increasing socio-economic status in a similar fashion to cohort fertility rates. (White et al., 2008)

Determinants of cumulative fertility

The determinants of cumulative fertility have been found largely the same as those of cross-sectional fertility. Socio-economic variables, desired fertility, contraception etc. are among the many variables, which have been shown to influence cumulative fertility. A review of evidence from across sub-Saharan Africa showed that demographic, economic and cultural factors all play a role in determining cumulative fertility. In Ghana, age at first marriage, level of education, religion and form of marriage have all been found to influence cumulative fertility. (Gaisie, 1984) (Cleland, Onuoha, & Timaeus, 1994)

(Garenne, 2008)

CONTRIBUTION OF URBAN RESIDENCE AND OTHER CONTEXTUAL FACTORS VERSUS INDIVIDUAL-LEVEL FACTORS TO CUMULATIVE FERTILITY

Both contextual and individual-level factors have been studied as determinants of fertility. In a review of fertility in sub-Saharan Africa, Cleland et al. in 1994 observed that analysis at different contextual levels (regional versus country level in this particular case) captured the influence of different factors (country-level variation versus region-wide characteristics) of fertility. Other studies have captured the influence of various individual-level factors on cumulative fertility. Gaisie in 1984 for example, applied the proximate determinants of fertility model ((Bongaarts, 1978; Bongaarts et al., 1984). Kravdal in 2002 applied a multilevel framework to examine the effect of education on fertility across 22 countries in sub-Saharan Africa. His analysis showed that the average educational level of a community makes a significant contribution to the fertility levels of the women in the community irrespective of their own individual characteristics

(individual educational levels included). (Kravdal, 2002) While a few other studies have attempted to simultaneously consider contextual and individual-level factors and their influence on demographic variables, this search did not unearth any other multilevel studies of cumulative fertility in the sub-Saharan African context.

REVIEW OF MULTILEVEL METHODS

Introduction:

This section provides a broad overview of multilevel methods and the theory underlying them. While not a comprehensive review of multilevel methods and their applications, it provides a useful introduction to the field and is hopefully simplified enough for the uninitiated whiles having enough depth to enable a critical reading of its application in this study.

What is multilevel modeling

Derived from the “contextual analysis” methods of the 1940s and developed in the 1970s in education research, multilevel analysis is now a mainstream research tool and has been applied in several fields including public health. The recent upsurge in the application of multilevel analysis in research has paralleled the increase in availability of powerful computing systems, which have made it possible to do complex estimation relatively quickly and painlessly

Multilevel analysis is a method of analysis that incorporates both individual and group level variance to model an outcome. Thus it allows the effects of both contextual and individual factors to be simultaneously estimated. Used in this sense, we refer only to the application of multilevel methods to data analysis. However, the concepts are applicable to all stages of research design, implementation and evaluation. One way in which multilevel methods are applied in research design is in the use of multi-stage sampling techniques where individuals are nested in successively more aggregated groups.

In real life, individuals exist in contexts, which influence, and are influenced by them. For example, a person’s health status may be affected by environmental pollution while his/her use of a car contributes to the same said pollution. It is generally accepted in the social sciences that the social and economic environment as much as individual goals and characteristics shape people's behavior. Multi-level analysis incorporates information from multiple levels of observation in studying the determinants of phenomena. Multilevel analysis, by combining elements from both levels of social reality, permits greater concordance between the theoretical views and the models employed for studying behavior.

Although the terms contextual analysis and multilevel analysis often have been used synonymously (Hermalin, 1986) today's multilevel models are more broadly applicable than the earlier contextual models in that they allow examination of between-group as well as within-group variability. Multilevel methods simultaneously analyze groups (or samples of groups) and individuals within them (or samples of individuals within them), for variability at both the group level and the individual level, and assess the role of group-level and individual-level constructs in explaining variation among individuals and between groups. For example, a study may have information on a sample of neighborhoods and on the individual-level characteristics of a sample of individuals within each neighborhood.

Multilevel modeling developed in response to the problem of how to handle hierarchical data–that is data that includes both individual and aggregated or contextual variables. Since the study subjects are correlated on the higher-level variables, the underlying assumptions of the model may be violated and wrong conclusions may be drawn.

Some researchers have used two approaches to work around this problem. Some have aggregated all variables to the contextual or group level and analyzed the aggregated outcome at that level. This presents two problems. Firstly, there is a loss of information in the process of aggregation. This reduces the precision of estimation. Also, it introduces the danger of committing the ecological fallacy–i.e. making individual-level inferences based on group-level relationships.

The second approach used by some researchers involves ignoring the hierarchical structure and treating the group-level variable as an individual level variable in the analysis. The problem with this arises because of the assumption in OLS regression that model residuals are independent of each other. This is violated if study subjects share the influence of a common context. If that contextual effect is thrown in as an independent variable, model residuals may end up correlated with each other leading to biased standard error estimates and increasing the likelihood of making a type I error. . (Bryk & Raudenbush, 1992; DiPrete & Forristal, 1994; Duncan, Jones, & Moon, 1998; Hermalin, 1986; Kreft, Kreft, & de Leeuw, 1998; Wong & Mason, 1985)

The multilevel approach is derived from a combination of the individual-level and group approaches to handling hierarchical data. It avoids the two problems above by allowing heterogeneity in the variance estimates at the different levels. The hierarchical model may be derived mathematically from a combination of the two approaches above. To this end, we start with a simple individual-level linear regression model as seen in equation 1 below. Here, a continuous outcome y is modeled as a linear function of a predictor x_1. In this model, the average level of the outcome when the predictor is zero or some other null value is given by β_0 (the intercept of the regression line) while β_1 represents the change in the outcome variable per unit change in the predictor (or the slope of the regression line).in this first equation, both outcome and predictor are measured for each individual. The final component of the model is an error or residual term, which represents the difference between the observed values of the outcome and the values predicted by the model for each value of the predictor.

The second equation shows what the model would look like if instead of measuring outcome and predictor for each individual, individuals are grouped and deemed to share a common average level of the outcome variable within each group. In this case, for each individual i, in group j, the measured outcome is y_{ij} and this is made up of 2 components–a group-level average for the outcome variable β_{0j} and an error term e_{0ij} representing the deviation of that individual's measured outcome from the group's average β_{0j}. Further, β_{0j} is shown to be made up of two components: the overall average baseline level of the outcome variable (β_0, as we saw earlier) and a stochastic term μ_{0j} representing the deviation of the jth group's intercept from β_0. Thus, in this model, we have two error terms representing the deviation of each group's baseline average from the overall baseline average, and the deviation of each individual's outcome from the group's average.

These two approaches may then be combined to obtain equation 3. Here, the predicted outcome for the i^th individual in group j is seen to made up of an average component ($\beta_0 + \beta_1 x_{1ij}$) and a variance element ($e_{0ij} + \mu_{0j}$). The average component is seen to be made up of an overall baseline average outcome value β_0 and an effect estimate for the predictor β_1. This effect estimate is seen to be the same across all groups. The variance components are μ_{0j} representing the deviation of each group's average from the overall baseline intercept value β_0 and e_{0ij} representing each individual's outcome's deviation from his/her group's average value. In effect what this means is that, each group has a different baseline value but the effect of the predictor remains the same for all groups. Graphically, this is seen as a set of parallel regression lines, one for each group, each with its own intercept.

In reality, it is not always credible to assume a constant effect estimate across groups. It is possible to allow the effect estimate to vary between groups. In this case, the effect estimate is split into two: a fixed component, β_1, which is the same across groups and a stochastic element μ_{1j} which varies from group to group. This introduces the additional error term $\mu_{1j}x_{1ij}$ indicating that the residuals now vary with the value of the predictor. This can be further extended to allow for heterogeneity at the individual level by adding a term to account for the variation of the effect estimate with individual values of the predictors variable.

Equation 1

$$Basic\ level\ 1\ OLS\ model$$

$$\boldsymbol{y_i = \beta_0 + \beta_1 x_{1i} + e_{0i}}$$

Equation 2

$$Level\ 2\ (grouped)\ model$$

$$\boldsymbol{y_{ij} = \beta_{0j} + e_{0ij}}$$

$$where\ \beta_{0j} = \beta_0 + \mu_{0j}$$

Equation 3

$$combining\ the\ two\ models\ to\ allow\ for\ level\ 2\ effects\ in\ basic\ OLS\ model$$

$$y_{ij} = \beta_{0j} + \beta_i x_{1ij} + e_{0ij} = (\beta_0 + \mu_{0j}) + \beta_i x_{1ij} + e_{0ij}$$

$$rearranging\ terms, we\ get$$

$$\boldsymbol{y_{ij} = \beta_0 + \beta_1 x_{1ij} + (e_{0ij} + \mu_{0j})}$$

Equation 4

$$allowing\ for\ heterogeneity\ at\ the\ individual\ level\ (level\ 1)$$

$$y_{ij} = \beta_0 + \beta_{1j} x_{1ij} + (e_{0ij} + \mu_{0j})$$

$$where\ \beta_{1j} = \beta_1 + \mu_{1j}$$

$$thus\ we\ have$$

$$\boldsymbol{y_{ij} = \beta_0 + \beta_1 x_{1ij} + (e_{0ij} + \mu_{1j} x_{1ij} + \mu_{0j})}$$

Equation 5

$$allowing\ for\ heterogeneity\ at\ level\ 2$$

$$y_{ij} = \beta_0 + \beta_{1ij} x_{1ij} + (e_{0ij} + \mu_{1j} x_{1ij} + \mu_{0j})$$

$$where\ \beta_{1ij} = \beta_1 + e_{1ij}$$

$$thus\ we\ have$$

$$\boldsymbol{y_{ij} = \beta_0 + \beta_1 x_{1ij} + (e_{0ij} + e_{1ij} x_{1ij} + \mu_{1j} x_{1ij} + \mu_{0j})}$$

As seen above, the error structure of multilevel models can get quite complex, especially when dealing with more than two levels. This makes multilevel methods computationally demanding though as computers have become cheaper and more powerful, these methods have become easier to apply.

As we mentioned above, the individuals within groups may be correlated with each other and this makes the variance structure of multilevel models even more complex as they have to account for the covariance between observations. This leads to variance models with quadratic forms though they can be restricted to take linear or even constant forms.

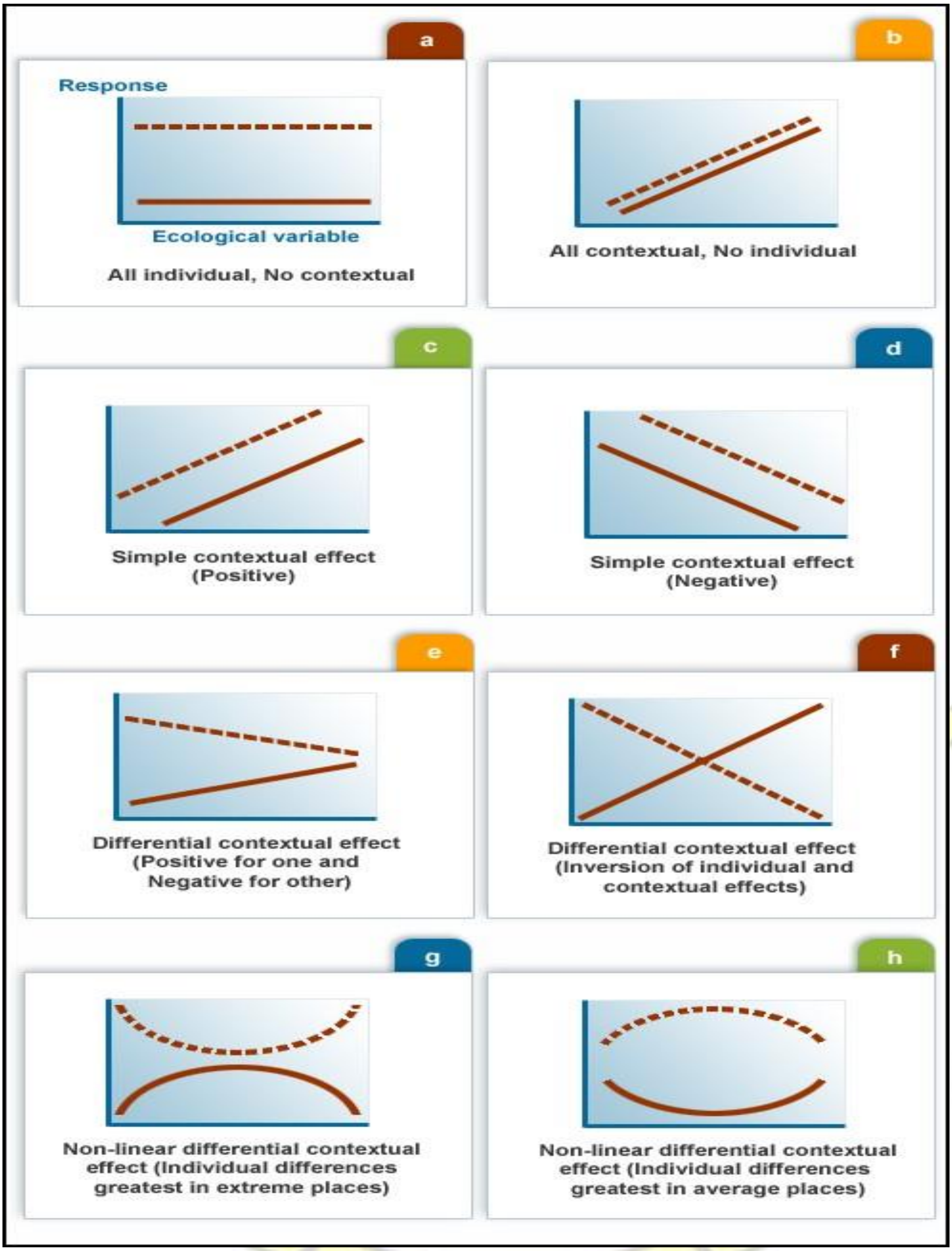


Figure 2-2 Variations of Compositional vs. Contextual Effect Models

Source: Subramanian, 2003

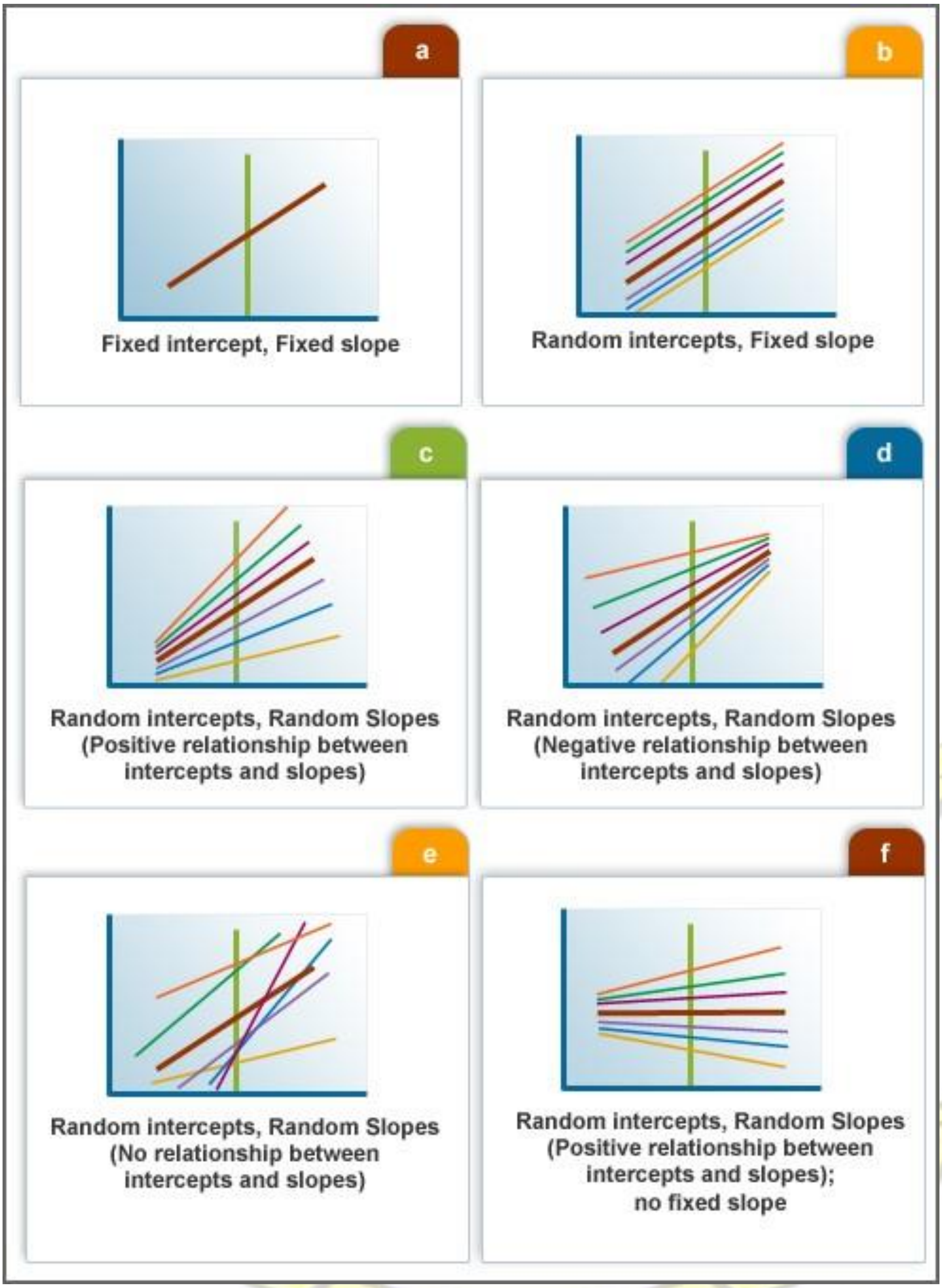


Figure 2-3 Different forms of multilevel models

Source: Subramanian et al, 2003

One of the most interesting things multilevel models allow us to do is to partition the total variance into an individual-level component and a group-level component. In its simplest form, this takes the form of the intra-class correlation coefficient defined in its simples form as

Equation 6

$$ICC = \frac{\sigma_{\mu}^{2}}{\sigma_{\mu}^{2} + \sigma_{e}^{2}}$$

The intraclass correlation coefficient is analogous to the Pearson's correlation coefficient except that each observation is centered using the pooled mean and standard deviation rather than the individual's mean and standard deviation. (Kim, Subramanian, & Kawachi, 2006; Subramanian, Jones, & Duncan, 2003)

CHAPTER 3: METHODOLOGY

INTRODUCTION

In this chapter we give an account of research design, data handling, and analysis. This gives a basis for evaluating the quality of the data used in this study and the validity of the findings made. In addition, the limitations and strengths of the study are discussed.

RESEARCH METHODS AND DESIGN

This study analyzed secondary data from the second round of the Performance, Monitoring and Accountability 2020 (PMA2020) Ghana survey. The PMA2020 survey uses a mobile-assisted data collection system built on the Open Data Kit Collect software on mobile phones and other mobile devices, to routinely collect data and update key family planning indicators. It is a multi-center multinational initiative funded by the Bill and Melinda Gates Foundation and implemented by the Johns Hopkins School of Public

Health. In Ghana, the local implementing partner is the Kwame Nkrumah University of Science and Technology. PMA2020 aims to collect a nationally representative sample of data from households and service delivery points in selected sentinel sites, to estimate family planning and key water and sanitation and health (WASH) indicators on an annual basis in ten pledging countries. (PMA2020, 2013)

The PMA2020 surveys involve interviewing a nationally representative probability sample of females aged 15 to 49 years and a probability sample of health facilities, pharmacies, and retail outlets that offer family planning services. Female respondents answer questions on their birth histories, fertility preferences, use of family planning methods, and reproductive health.

The survey in Ghana employed a multi-stage cluster design, urban-rural, all ten regions and districts as the strata. One hundred (100) enumeration areas (EAs) were sampled and in each, all households and service delivery points (SDPs) were listed and mapped. In each EA 42 households were then randomly selected for inclusion in the survey. A roaster of the members in the selected households is created and all eligible women between 1549 years were interviewed.

Study population

The study population for this study was all women aged 15 to 49 years living in Ghana.

DATA COLLECTION TOOLS AND TECHNIQUES

This study made use of data from the second round of the PMA 2020 survey. The methodology of this survey is described in (Anglewicz, 2014). The variables used in this analysis were extracted using the data capture tool described in appendix 1. This tool was implemented electronically in Microsoft Excel ®. The procedure used to extract the variables is described below.

The dataset used for this study was obtained with the kind permission of the Principal Investigator, and Program's Data Manager based in Ghana. The dataset was stored on a password-protected computer. The dataset in the form used by the author was completely anonymized – all references, which could be used to identify respondents, had been removed.

The PMA2020 survey used three types of questionnaires: the household questionnaire, female questionnaire and service delivery point questionnaire. This study made use of the data from the female questionnaire. This questionnaire consisted of 500 questions consisting of both open-ended and closed questions.

VARIABLES

In all the PMA2020 gathered data on 490 variables. Of these, 8 variables made up of one outcome and 7 predictor variables were extracted for use in the analysis. These are discussed in the table below.

Table 3-1 Study Variables

Variable	Definition	Remarks
Age	Age in 5-year categories	Categorized as 1519 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40- 44 years and 45-49 years.
Marital status	Current marital status	Categorized as never married, currently married and separated/divorced/ widowed
Wealth	Wealth quintile	Quintiles of household wealth
Education	Highest level of education reached by respondent	Categorized as None, Primary, Junior High School, Senior High School and Tertiary
Cumulative fertility	Total number of children ever born to a respondent at the time of the interview	
Ever used FP	Past or current use of contraceptives for the purpose of fertility regulation	Categorized as yes/no
Age at first sex	Self-reported age at which respondent had first sexual intercourse	
District	District of residence at time of interview	81 unique answers
Residence	Residence in an urban or rural area	Categorized as Urban/Rural

DATA ANALYSIS

The analysis of the data proceeded in three stages – an initial exploration of the data with descriptive analysis as an output, then multivariate linear regression modeling, and finally multilevel regression modeling.

In the initial exploration of the data, descriptive summaries were constructed for the variables of interest. A line-wise deletion method was used to handle missing values. Categorical variables were tabulated and continuous variables were summarized using their means and standard deviations. Cross tabulations and the Pearson's chi squared statistic were used to explore associations between the independent variables and the outcome variable, cumulative fertility.

In the second phase of the analysis, two multivariable adjusted ordinary least squares regression models were developed. The first model included age, marital status, wealth, education, age at first sex and ever used FP as independent variables. Dummy variables were added to the model for each level of the categorical variables age, marital status, wealth, education and ever used FP, while omitting the reference category. The second ordinary least squares regression model was basically first model with interaction terms added for age against education, marital status, wealth, age at first sex and ever used FP as well as for education against wealth. Both models were assessed for how well they fitted the data using the adjusted coefficient of determination (adjusted R squared) and then compared with each other using a likelihood ratio test to determine which fitted the data best.

Finally, a random effects 2-level model was developed. To do this, we started with the multivariable regression model with interaction terms included and added second level predictors. Three models were thus developed – the first with urban/rural residence as the second level predictors, the second with district as the predictors and the last with a stratification variable combining district and urban/rural residence. The fit of these models was determined using their adjusted R squared values while the relative contributions of the first and second level variables to the variance of the outcome variable was determined using the R squared between, R squared within and ρ parameters.

ETHICAL CONSIDERATION

The Kwame Nkrumah University of Science and Technology/Komfo Anokye Teaching Hospital Committee on Human Research, Publications and Ethics approved the mother study.

LIMITATIONS AND STRENGTHS OF STUDY

In this section, we discuss some of the limitations and strengths of this study.

A major limitation of this study was that some variables that had been found to be associated with fertility in previous studies, could not be included because they were not captured by the survey: religion, occupation and age at first marriage. It has been shown in that religious affiliation significantly influences fertility. Some religious groups are strongly pronatalist and thus encourage their members to have as many children as possible. Others prohibit certain fertility-limiting practices such as contraception and abortion. Further, religion often has a hand in how women are treated and the degree of autonomy they can exhibit regarding reproductive issues. (John C. Caldwell & Caldwell, 1987; Chamie, 1981; Lehrer, 1996)

Another such variable, which would have been good to have in the models, is occupation/employment status. It has been shown that the need to work is one of the reasons that women delay marriage and space their childbirths. (Ahn & Mira, 2002; Bernhardt, 1993) A third variable that would have helped the models is age at first marriage. While the models include age at first sex as a measure of exposure to sexual activity, it has been shown that marriage is a major driver of fertility (Bongaarts, 1982).

Sexual activity outside marriage is often recreational rather that procreative in purpose. Thus, the age at first marriage/duration of marriage would have been a useful additional predictor of fertility to include in the models. The characteristics of the husbands of the women were also unfortunately not available to be included in the models even though it is known that these influence fertility (Blood Jr & Wolfe, 1960; Sorenson, 1989).

Also, the second-level variables used in the models were restricted to district and urban/rural residence. Beyond these, there are many other contextual factors, which could have been looked at if data on them were available. Examples of such variables are: access to facilities providing family planning services, the status of women in the district etc. (Balk, 1994; Cain, 1984)

Another limitation of this study is that it is restricted to looking at two levels of variation, individual and district. It would have been informative to extend the models to look at variation at levels above the district such as region, as well as more granular levels such as communities. It is well established that the scale at which a study is done has a major impact on the findings, which are made from that study. (Cash et al., 2006; Turner, O'Neill, Gardner, & Milne, 1989) For example, it is possible to find no contextual effects at the district level when regional level models show significant contextual effects. That said, the district level was chosen since it is the level at which programs aimed at fertility limitation such as family planning are directly implemented. In Ghana, many women obtain family planning services at health centers, CHPS compounds and district hospitals, all of which fall under the purview of the district health management teams. Thus, the district level was chosen so that this study could contribute to our understanding of the factors affecting fertility at that level with a view to informing future policy-making. A further limitation of this study is the fact that it is based on a sample survey and, as with all surveys, subject to sampling error.

The main strength of this study derives from the analytical approach used. The multilevel modeling approach used allows the simultaneous consideration of individual and aggregate level effects.

ASSUMPTIONS

The models used in this study are based on a number of important assumptions. They assume that the women interviewed are nested within the various districts and residences. It further assumes that these districts/ residences have been the only districts/residences providing contextual influences on the fertility of these women. It thus ignores the influences of migration and previous residences.

One of the fundamental assumptions of generalized linear models is independence of observations. This would require that the fertility of any one woman be independent of the fertility of all other women in the study. Multilevel modeling allows us to account for the common contextual influence of the aggregate levels and thus allows for this to be violated without voiding model validity. However, model residuals are assumed to be uncorrelated between the individual and contextual levels. Also, the model errors at the aggregate level are assumed to be independent.

SAMPLE SELECTION

The PMA 2020 round 2 dataset used had a total of 4981 observations. This was trimmed according to the following flow-chart to obtain a final sample size of 3711.

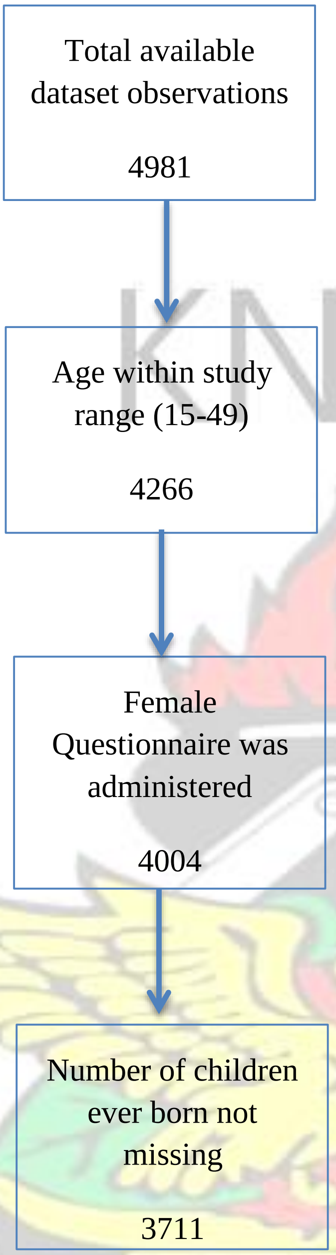


Figure 3-1 Sample selection flow-chart Source:

Author's construct, 2015

CHAPTER 4: RESULTS

INTRODUCTION

In this chapter, we present the results of our analysis. First we provide a description of the study sample in terms of its socio-demographic characteristics (age, education, wealth and marital status) and residence. Next, we present cumulative fertility estimates by demographic characteristics and residence. Following that, we present and compare two individual-level ordinary least squares (OLS) linear regression models describing the relationship between demographic characteristics and cumulative fertility.

Subsequent to that, we extend the best fitting individual-level model to derive three different two-level hierarchical frameworks using residence, district and a combined residence-district variable as the contextual variables. These models are also compared and a best fitting model selected. Finally, we determine the contribution of district and residence (as contextual factors) to cumulative fertility.

SAMPLE CHARACTERISTICS

Similar numbers of respondents were interviewed from rural (53%) and urban (47%) settings. There was no significant difference in the distribution of age between the urban and rural women. The women ranged in age from 15 years to 49 years in both contexts with the average ages being 28.9 (SD±9.4) years for the urban women and 29.1 (SD±9.2) years for rural residents. In both cases, the respondent women were quite young and in the prime of their reproductive years (interquartile ranges = 22 – 36 years urban, 21 – 36 years rural). Age was categorized into 5-year age groups to conform to demographic conventions. At the district level however, there were significant differences in the age distributions ($p < 0.001$). In education, significant differences existed in the distributions between urban and rural settings ($p < 0.001$). As expected, levels of educational attainment were higher in urban than rural areas; 37% of respondents in rural areas had no formal education compared with 15% of urban dwelling respondents, and 72% of urban respondents had been educated beyond the primary level compared with just over 40% for the rural dwellers. Only 1.3% of rural dwellers had any form of tertiary education compared with 12% of urban women. Overall, three quarters of the women interviewed had had some form of formal education.

Also consistent with expectations, the rural dwelling respondents were generally poorer than the urban dwellers. Wealth was not found to differ significantly by age. This is consistent with the fact that, the data on wealth were collected and calculations of the wealth index done at the household level rather than for individual women. Even though wealth quintiles were computed for households rather than individuals, the sample was quite evenly distributed across wealth quintiles.

Almost two thirds of the respondents were currently married while 8% were divorced, widowed or separated (i.e. had been previously married but were not currently in a marital union). More than a quarter of the women interviewed had never been married before and were not in any kind of sexual relationship at the time of the interview. A higher proportion of women in the rural areas were married when compared with the urban areas (69% against 57%).

About 34% of the women interviewed had ever-used a contraceptive. There was no significant difference between urban and rural women. The mean age at first sex was 16 years (SD±7 years). This did not differ significantly between urban and rural women.

Table 4-1: Study Sample Characteristics by Residence

	Rural		**Urban**		**Total**	
Age category	**No.**	**%**	**No.**	**%**	**No.**	**%**
15-19	384	19.2	289	16.9	673	18.1
20-24	371	18.5	322	18.8	693	18.7
25-29	346	17.3	345	20.1	691	18.6
30-34	271	13.5	244	14.2	515	13.9
35-39	258	12.9	225	13.1	483	13
40-44	214	10.7	157	9.2	371	10
45-49	158	7.9	131	7.6	289	7.8
Total	1997		1702		3711	
Pr = 0.152						
Highest level of school completed						

Never attended	736	36.8	250	14.6	986	26.6
Primary	459	22.9	231	13.5	690	18.6
Middle/JSS	643	32.1	625	36.6	1268	34.2
Senior/ SSS	138	6.9	393	23	531	14.3
Higher	26	1.3	210	12.3	236	6.4
Total	2002		1709		3711	
Pr < 0.001						
Quintile of Wealth Index						
Poorest	769	38.5	50	2.9	819	22.1
Second poorest	616	30.8	173	10.2	789	21.3
Middle	376	18.8	319	18.7	695	18.8
Second wealthiest	169	8.5	522	30.7	691	18.7
Wealthiest	67	3.4	638	37.5	705	19.1
Total	1997		1702		3699	
Pr < 0.001						
Marital status						
Never in Union	467	23.4	592	34.7	1059	28.6
Married	1382	69.2	966	56.6	2348	63.4
Separated/Divorced	148	7.4	150	8.8	298	8
Total	1,997		1,708		3,705	
Pr < 0.001						
FP ever use						
No	1,316	65.8	1,125	65.8	2,441	65.8
Yes	683	34.2	585	34.2	1,268.00	34.2
Total	1,999		1,710		3,709	100
Pr=0.978						

Source: PMA2020, 2014

CUMULATIVE FERTILITY BY SOCIO-DEMOGRAPHIC CHARACTERISTICS AND RESIDENCE

In this section, we describe cumulative fertility as measured by mean number of children ever born and compare it by residence and socio-demographic characteristics. As seen from Table 4-2, cumulative fertility as measured by the mean number of children ever born to a woman of reproductive age varied significantly between urban and rural areas (mean number of children ever born, $p < 0.001$). Urban women had significantly fewer children than rural women. Consistent with expectations, the mean number of children ever born increased with increasing age for both urban and rural women however, while urban women above 35 years of age had between 3.2 and 3.9 children, their rural counterparts had between 4.3 and 5 children.

Education was seen to have a significant depressant effect on the mean number of children ever born and this effect was observed to have increased as the level of education increases. While women with no education had an average of 4 children, those with at least a senior high school education had less than 1 child each.

Wealth was also seen to attenuate the cumulative fertility although to a lesser extent than education. The effect seen here was the same for both rural and urban dwellers.

Marriage was seen to be a significant driver of fertility with married women having 2.8 more children than those who had never been in a union. There wasn't a significant difference in cumulative fertility between those currently married and those separated/divorced/widowed. Rural women had higher cumulative fertility irrespective of marital status.

Interestingly, women who had used FP before had higher cumulative fertility than those who hadn't. As seen with the other covariates, urban women again had fewer children allowing for FP usage.

Table 4-2 Mean numbers of Children Ever Born by sample characteristics

	Rural	Urban	Total
Age category			
15-19	0.2	0.1	0.1
20-24	1.2	0.7	1
25-29	2.3	1.4	1.9
30-34	4	2.4	3.2
35-39	4.3	3.2	3.8
40-44	5	3.4	4.3
45-49	5	3.9	4.5
Highest level of school completed			
Never attended	4.1	3.6	4
Primary	2.5	2.4	2.5
Middle/JSS	1.7	1.7	1.7
Senior/ SSS	0.8	1	0.9
Higher	0.7	0.8	0.8
Quintile of Wealth Index			
Poorest	3.2	3.1	3.2
Second poorest	2.5	2.6	2.5
Middle	2.4	2	2.2
Second wealthiest	2.3	1.8	1.9
Wealthiest	1.4	1.4	1.4
Marital status			
Never in Union	0.3	0.2	0.3
Married	3.4	2.6	3.1
Separated/Divorced	3.4	2.6	3
FP ever use			
No	2.3	1.5	2
Yes	3.4	2.3	2.9
Total	2.7	1.8	2.3

DETERMINANTS OF FERTILITY

An ordinary least squares (OLS) regression model with age category, wealth quintile, education, marital status, age at first sex and history of family planning use was run and compared with a second OLS regression model with the same covariates but with terms added for age interactions with education, wealth, marital status and history of family planning, and an interaction term for education against wealth. The estimates for the regression coefficients (with associated 95% confidence intervals) for the two models are presented below.

Both models performed very well in accounting for variations in cumulative fertility. The coefficient of determination for the base OLS model was 0.609 while that for the model with interactions was 0.620. A likelihood ratio test comparing the two models (with the base model assumed to be nested in the model with interactions) had a $p < 0.001$. Thus, despite being more parsimonious, the base model was rejected in favor of the model with interactions. It can be seen that age interacted significantly with education, wealth, family planning use and age at first sex.

The inclusion of the interaction terms caused some considerable shifts in the magnitudes (and sometimes directions) of the regression coefficients for several covariates. Age was seen to have a significant, non-linearly increasing relationship with cumulative fertility in both models. Between ages 20 and 24, there is a small increase in cumulative fertility compared with the 15 -19 year olds. There is a much steeper increase between 25 and 39 years and then a plateauing of the effect afterwards. Further, the effect of increasing age categories on cumulative fertility became much more pronounced once the age interactions were introduced.

Being currently married increased a woman's cumulative fertility by about 1 child compared with those women who had never been in a union. The magnitude of this effect was reduced to about 0.8 after accounting for the interaction between age and marital status. For those previously married who were currently separated, divorced or widowed, the base model showed an increase in cumulative fertility of about 0.3. This effect was reduced to insignificance after accounting for the age interactions with marital status.

History of FP use was significantly associated with an increase in cumulative fertility of about 0.4 compared with those who had never used FP. This effect was attenuated to insignificance once the age interaction terms were introduced in the model.

Education was seen to have a depressive effect on cumulative fertility in both models though this effect became less pronounced with the inclusion of interaction terms. In fact, once the interaction terms were added, it was found that, education beyond primary school level did not have a significant effect on cumulative fertility.

Excluding age interactions, wealth was seen to significantly decrease cumulative fertility. However, this effect almost disappeared completely once age interactions were considered.

Cumulative fertility was seen to decrease slightly with each unit increase in age at first sex. However, this effect was completely attenuated once age interactions were taken into account.

Age was found to significantly positively interact with history of FP use and negatively with education, wealth and age at first sex. There was no significant interaction between age and marital status, and education and wealth. [Table 4-3]

Table 4-3 Multivariate Linear Regression Models

	MODEL1 (BASE MODEL)	MODEL 2 (WITH AGE INTERACTION TERMS)
Age Category		
15-19	Ref	Ref
20-24	0.547***	0.806***
	[0.360,0.733]	[0.614,0.997]
25-29	1.268***	1.851***
	[1.059,1.477]	[1.592,2.110]
30-34	2.406***	3.327***
	[2.180,2.631]	[2.964,3.690]
35-39	2.952***	4.173***
	[2.720,3.184]	[3.698,4.649]
40-44	3.462***	4.971***
	[3.218,3.707]	[4.369,5.573]
45-49	3.667***	5.537***
	[3.409,3.925]	[4.799,6.275]
Marital Status		
Never in union	Ref	Ref
Married	0.965***	0.813***
	[0.810,1.120]	[0.458,1.167]
Separated/Divorced	0.337**	-0.16
	[0.110,0.563]	[-0.987,0.666]
FP ever use		
Never used FP	Ref	Ref
Ever used FP	0.356***	-0.00377
	[0.249,0.462]	[-0.376,0.368]
Highest Level of School Completed		
Never attended	Ref	Ref
Primary	-0.745***	-0.326**
	[-0.895, -0.594]	[-0.572, -0.0805]
Middle/JSS	-0.986***	-0.288
	[-1.132, -0.841]	[-0.692,0.117]
Senior/ SSS	-1.248***	-0.372
	[-1.440, -1.056]	[-0.980,0.235]
Higher	-1.672***	-0.475
	[-1.926, -1.418]	[-1.348,0.399]

Quintile of Wealth Index

Poorest	Ref	Ref
Second Poorest	-0.234**	0.0769
	[-0.383, -0.0848]	[-0.123,0.277]
Middle	-0.247**	0.365*
	[-0.406, -0.0883]	[0.0373,0.693]
Second richest	-0.499***	0.433
	[-0.665, -0.333]	[-0.0565,0.922]
Richest	-0.708***	0.561
	[-0.890, -0.525]	[-0.127,1.250]
Age at first sex	-0.0293***	0.0146
Education× Wealth		
Intercept	1.406***	0.843***
	[1.227,1.585]	[0.602,1.084]
N	3477	3477
R-squared	0.609	0.620

95% confidence intervals in brackets
* p<0.05, ** p<0.01, *** p<0.001

	[-0.0388, -0.0197]	[-0.0117,0.0408]
Age×Marital status		0.0105 [-0.00342,0.0245]
Age×Ever used family planning		0.0123* [0.0000978,0.0246]
Age×Education		-0.0106*** [-0.0169, -0.00433]
Age×Wealth		-0.0119*** [-0.0165, -0.00724]
×		-0.00169** [-0.00275, -0.000618]
		0.007 [-0.0419,0.0559]

Age Age at first sex

MULTILEVEL MODELS

The OLS model with the interaction terms was selected to explain the effects of the selected individual-level covariates on cumulative fertility. This model was then extended to account for contextual effects due to residence, district level factors and a combination of both. Three different two-level models were developed to account for the different levels of contextual effects due to residence, district and both respectively. The three models produced very similar effect estimates to the individual-level OLS model with interactions. The main purpose of this section of the analysis was to determine how much other variation in cumulative fertility could be attributed to contextual effects as opposed to the compositional effects elucidated by the individual-level OLS models.

All three models performed well. The overall coefficients of determination for the models were 0.620, 0.618 and 0.619 for the models with residence, district and a residence*district stratum as the contextual levels respectively.

The model with residence as the contextual variable was able to explain 60% of the variance within the urban-rural categories and all the variation between the groups. However, residence alone appears to contribute nothing to the variation in cumulative fertility.

The second model, which uses district, was also able to explain 60% of the variation in the outcome variable between individuals in a district. It further accounted for about twothirds of the variation in cumulative fertility between districts. District-level contextual factors were shown to account for 3.5% of the variation in the outcome variable.

Defining the contextual variable as a compound of residence and district improved the model's ability to account for inter-group variation slightly but decreased the amount of variation in cumulative fertility attributable to contextual factors to just above 3%

Table 4-4 Multilevel Models

CONTEXTUAL VARIABLE:	MODEL 3 URBAN/RURAL RESIDENCE	MODEL 4 DISTRICT	MODEL 5 URBAN*DISTRICT
Age category			
15-19	Ref	Ref	Ref
20-24	0.806***	0.833***	0.838***
	[0.614,0.997]	[0.644,1.023]	[0.648,1.028]
25-29	1.851***	1.897***	1.900***
	[1.592,2.110]	[1.640,2.154]	[1.642,2.158]
30-34	3.327***	3.380***	3.372***
	[2.964,3.690]	[3.018,3.742]	[3.010,3.735]
35-39	4.173***	4.236***	4.213***
	[3.698,4.648]	[3.762,4.711]	[3.737,4.688]
40-44	4.971***	5.026***	4.999***
	[4.369,5.573]	[4.425,5.627]	[4.397,5.601]
45-49	5.537***	5.605***	5.572***

	[4.799,6.274]	[4.869,6.341]	[4.835,6.309]
Marital status			
Never in union	Ref	Ref	Ref
Married	0.813***	0.880***	0.834***
	[0.458,1.167]	[0.528,1.231]	[0.482,1.186]
Separated/Divorced	-0.16	0.0638	-0.052
	[-0.986,0.665]	[-0.755,0.882]	[-0.872,0.768]
Ever used FP			
Never used FP	Ref	Ref	Ref
Ever used FP	-0.00377	-0.0315	0.00199
	[-0.375,0.368]	[-0.399,0.336]	[-0.366,0.370]
Highest level of education			
Never attended	Ref	Ref	Ref
Primary	-0.326**	-0.232	-0.263*
	[-0.571, -0.0805]	[-0.479,0.0160]	[-0.510, -0.0161]
Middle/JSS	-0.288	-0.125	-0.193
	[-0.692,0.117]	[-0.532,0.281]	[-0.599,0.214]
Senior/ SSS	-0.372	-0.158	-0.26
	[-0.980,0.235]	[-0.767,0.451]	[-0.869,0.348]
Higher	-0.475	-0.21	-0.358
	[-1.348,0.399]	[-1.084,0.665]	[-1.233,0.517]
Quintile of Wealth Index			
Poorest	0	0	0
Second Poorest	0.0769	0.155	0.0889
	[-0.123,0.277]	[-0.0555,0.365]	[-0.122,0.299]
Middle	0.365*	0.444**	0.356*
	[0.0375,0.693]	[0.106,0.782]	[0.0177,0.694]
Second richest	0.433	0.545*	0.453
	[-0.0563,0.922]	[0.0469,1.044]	[-0.0464,0.952]
Richest	0.561	0.781*	0.667
	[-0.127,1.250]	[0.0847,1.478]	[-0.0311,1.364]
Age at first sex	0.0146	0.00947	0.00922
	[-0.0117,0.0408]	[-0.0166,0.0355]	[-0.0169,0.0354]

Age*Marital status	0.0105 [-0.00342,0.0245]	0.0071 [-0.00669,0.0209]	0.00853 [-0.00528,0.0223]
Age*Ever used family planning	0.0123* [0.000102,0.0246]	0.0144* [0.00231,0.0265]	0.0133* [0.00116,0.0254]
Age*Education	-0.0106*** [-0.0169, -0.00433]	-0.0108*** [-0.0170, -0.00459]	-0.0106*** [-0.0168, -0.00434]
Age*Wealth	-0.0119*** [-0.0165, -0.00724]	-0.0118*** [-0.0164, -0.00717]	-0.0119*** [-0.0166, -0.00730]
Age*Age at first sex	-0.00169** [-0.00275, -0.000618]	-0.00147** [-0.00253, -0.000402]	-0.00146** [-0.00253, -0.000399]
Education*Wealth	0.007 [-0.0418,0.0558]	-0.00158 [-0.0506,0.0474]	0.00494 [-0.0442,0.0541]
Intercept	0.843*** [0.602,1.084]	0.607*** [0.340,0.875]	0.717*** [0.455,0.980]
N	**3477**	**3477**	**3477**
R sq. within	**0.605**	**0.606**	**0.606**
R sq. between	**1**	**0.666**	**0.671**
R sq. overall	**0.62**	**0.618**	**0.619**
Rho	**0**	**0.0352**	**0.0304**

95% confidence intervals in brackets
p<0.05, ** p< 0.01, *** p<0.001

Source: Author's construct 2015

CHAPTER 5: DISCUSSION

INTRODUCTION

In this chapter, the results are discussed in detail and compared with similar work found in the literature on the determinants of fertility.

STUDY SAMPLE CHARACTERISTICS

Education

In this study, we observed a significantly lower level of educational achievement among rural women compared with urban women. This finding is consistent with the results of the 2014 Ghana Demographic and Health survey, which found that 28.5% percent of women in rural areas have no education, compared with 11% percent of women in urban areas. Further, it found that regions such as the Greater Accra Region, which are predominantly urban, have much higher levels of educational achievement than the three Northern regions, which are mainly agrarian and rural. This same pattern is repeated with literacy. The GDHS 2008 found that about half of all rural dwellers couldn't read at all compared to 22% of urban. This worrying situation reflects inequities in educational investment between urban and rural areas despite improvements in education overall. This situation has implications for the form that education programs to improve awareness of family planning and other fertility and health issues should take. (Gss & Macro, 2009) The inability of a large proportion of the target population to read and understand English means that, such campaigns have to be written or translated into the local dialect of each community and considering the diversity of Ghanaian languages, this implies the investment of significant resources. Further, rural-urban differentials in education have been linked to other socio-economic phenomena such as rural-urban migration, and differentials in child malnutrition. (Byerlee, 1974; John C Caldwell, 1968;

Fields, 1975; L. C. Smith & Haddad, 2000; L. C. Smith, Ruel, & Ndiaye, 2005)

Wealth

Wealth is notoriously difficult to measure and compare between urban and rural contexts. Any common measure has to attempt to capture the relative importance of different assets in the different contexts. For example, a bicycle for a rural dweller whose community has no paved roads and whose farm is half a mile from home may be worth just as much to its owner as a car to an urban dweller who faces a 16km daily commute to work. Further, the bicycle would not make sense to the urban dweller just as his car would add little value to the life of the rural farmer. The difficulty of quantifying the subjective value of assets leads many researchers to rely on assessments of the relative economic value of the assets. Another complicating factor is there is the concept of the prestige associated with certain assets irrespective of their economic value. For example, the rural farmer who owns a horse may be held in far higher esteem due to the prestige by his neighbors than the horse is actually worth. (Curtin, Juster, & Morgan, 1989; Juster, Smith, & Stafford, 1999; Kennickell, 2000)

However, note must be taken of the fact that, the wealth quintiles used were calculated using the same index for both rural and urban dwellers and thus, direct comparisons of wealth between urban and rural settings may be inappropriate. However, since wealth is treated as an individual level variable, it does not matter as much for the current analysis.

With this caveat in mind, it was not surprising that the asset-based index of wealth used in this study found that rural dwellers were generally poorer than their urban counterparts. This is consistent with the findings of the GDHS 2014, which also used an asset-based wealth measure for comparison and found significant differences I wealth between urban and rural folk. The GDHS chose a very detailed presentation format, listing the key variables used in the calculation of their index. Such an approach would have been impractical in our situation and a summary measure was used instead. Also important to note is that wealth in this study was calculated at the household level rather than the individual level. Within the household, women have varying access to resources and thus, household wealth may not translate into individual wealth.

Marital Status

Marriage is a cornerstone of the social fabric of Ghana. All ethnic groups value marriage and most women marry at least once during their lifetime (Nukunya, 2003). With that in mind, it is not surprising that almost two-thirds of respondents were married. The fact that almost a quarter of women in this study had never married reflects the rising age of marriage in Ghana due in part to higher levels of female education and employment.

(Hatti & Ohlsson, 1985; Yabiku, 2005) (Hofferth & Moore, 1979) Between 2003 and 2008, the median age at first marriage increased from 19.4 years to 19.8 years. The median age at first marriage has also consistently been lower in rural compared to urban areas. The urban-rural differentials in marital age may be ascribed in part to differences in educational attainment and employment. Marital status and age at marriage are important because marriage is the main driver of fertility in Ghana. (Malhotra, 1997; Van de Walle, 1968)

Family Planning use

This study found that the 34% of women, both urban and rural were either using contraception or had used some form of modern contraception in the past. This is consistent with what was found by the GDHS 2014 in which approximately 33% of women had used at least one method of modern contraception before. Ghana has had a persistently low usage of modern contraception with a moderate level of unmet need. While a major factor in fertility decline, it appears to have played a much lower key role in Ghana's experience of fertility decline over the past few decades. (Gss & Macro, 2009;

Tawiah, 1997)

Age At First Sex

The age of initiation of sexual activity for females is a very important predictor of fertility as it determines their length of fertility exposure. This is however, a very difficult variable to capture accurately in surveys(Zaba et al., 2004). It is highly susceptible to recall bias, responses that are socially desirable, and the response rate is often low. In the PMA2020 survey, the mean age at first sex was 16 years but the there was considerable variation (SD ± 7 years). Interestingly, there was no significant difference in the age at first sex between urban and rural dwellers(PMA2020, 2013). This is despite the fact that age at first marriage is known to differ significantly between the two groups. Taken together with the fact that, the mean age at first sex is almost 3 years lower than the median age at first marriage, it suggests that, significant amounts of premarital sex take place. This begs the question of how premarital sexual exposure affects fertility. It would be interesting to examine whether usage of contraception for example differs in the premarital period from the marital period– but that would be the subject of further research.

LEVELS OF CUMULATIVE FERTILITY BY SOCIO-ECONOMIC CHARACTERISTICS AND RESIDENCE

Overall cumulative fertility was significantly higher among rural and urban dwellers (2.7 vs. 1.8 children respectively). This pattern is consistent across age groups indicating that the age differentials in fertility are inherent to each residential group. The differentials in fertility were also observed across marital categories, and with usage of contraception. Wealth did not appear to make any difference to cumulative fertility. This suggests (though not formally tested) that rural-urban residence is an important factor in determining observed fertility.

DETERMINANTS OF CUMULATIVE FERTILITY

The multiple linear regression models of fertility indicate that accounting for all covariates, age, marital status, usage of contraception, education, wealth and age at first sex were all significantly associated with cumulative fertility if age-interactions were left out of the model. Increasing age, being married or divorced/separated, having ever used contraception were associated with increasing cumulative fertility while education, wealth and increasing age at first sex had a depressive effect on cumulative fertility.

The addition of interaction terms for age against the other covariates caused the association with age to strengthen while that with wealth, education, having ever used contraception and age at first sex reduced to insignificance. Being married was still significantly associated with increased cumulative fertility though the strength of the associating was decreased.

This pattern appears to suggest that the apparent effect of education, wealth, contraception and changes in age at first sex, are all modified by age and that, the observed effects are indeed mainly an age (or possibly cohort) effect, rather than a true effect of these covariates. Age is thus seen to be the most important determinant of cumulative fertility. This general pattern of associations persisted in the multilevel models with urban/rural residence, district or the urban-district strata as second level variables. Intuitively, age would be expected to increase the likelihood of obtaining higher levels of education, being wealthier, being married, and using contraception. Thus it would appear that the apparent effect of these covariates is driven in most part by age. Thus, age seems to exert the most significant compositional effect on cumulative fertility. In other words, the observed differences in cumulative fertility at the district level would appear to be driven mainly by their different age structures.

That said, the relationship of age with cumulative fertility was non-linear, with the steepest rise being between 25 and 39 years of age. This is consistent with the pattern of age-specific fertility rates observed in other surveys. For example, the GDHS 2014 found the highest age-specific fertility rates among those aged between 20 and 39 years with the peak fertility between 24 and 29 years of age. This pattern is also consistent with the mean age at first marriage being about 19 years. It would appear that the majority of child bearing occurs in marriage. This conclusion is reinforced by the observation that being married was consistently significantly associated with increasing fertility even after accounting for all other covariates. Also interesting was the finding that age did not significantly modify the relationship between marital status and fertility. It would appear thus that, education and wealth were seen to have significantly depressive effects on cumulative fertility. However, this effect all but disappeared once their interaction with age was introduced. This would suggest that, reproductive behavior (and by likely extension, fertility preferences) do not change much with socio-economic status. In other words, given all other circumstances equal, women will have similar numbers of children regardless of education or wealth. However, that said, it must be observed that, having at least primary school education did have a depressant effect on cumulative fertility further emphasizing the importance of providing at least basic education to women.

The effect of age at first sex on cumulative fertility was significantly modified by sex. Thus, the association between age at first sex and cumulative fertility differed among people of different age groups (or birth cohorts). This could reflect changing sociocultural norms. For example, while the median age at first sex was about 18.4 years for women in the GDHS 201408, the median age at first birth was 21 years with a definite increasing trend observed with age cohort. Thus, women are initiating sexual activity earlier, but marrying and having children later.

In the absence of an interaction term for age with contraception in the model, having ever used contraception was associated with an increase in cumulative fertility. This finding coupled with the fact that this apparent association disappears once the interaction with age is accounted for suggests that women may be using contraception to delay and space births and possibly to end childbearing once their optimum family sizes are reached. They do not appear to be using contraception to actually limit their family sizes.

CONTRIBUTION OF RESIDENCE AND OTHER DISTRICT LEVEL FACTORS VERSUS

INDIVIDUAL LEVEL FACTORS TO CUMULATIVE FERTILITY

The multilevel models all lead to one overall conclusion–contextual factors have a limited effect on fertility at the district level. District level factors such as urban/rural residence play only a small role in the determination of cumulative fertility. It appears that the differential effects observed for cumulative fertility at the district level may be attributed mainly to differences in their socio-demographic compositions. To be more specific, the differential age composition of these districts appears to be the major driver of cumulative fertility level differentials at the district level. This finding suggests that policies aimed at achieving fertility decline should aim at changing some of the fundamental socio-cultural practices associated with marriage. For example, efforts should be made prevent early marriage and encourage fertility limitation in marriage. Research shows that, the best ways to achieve these is by empowering women through education and the provision of economic opportunities(Abadian, 1996; Kabeer, 1999; Steele, Amin, & Naved, 1998). Ghana is culturally pronatalist. Most of its ethnic groups encourage and celebrate high fertility(Mensah-Kumah, 1986; B. K. Takyi, Gyimah, & Addai, 2006). It is seen as a validation of the essence of womanhood and the raison d'etre of marriage. Changing fertility preferences in such an atmosphere would require a total reorientation of social norms–something that cannot be achieved without improving education.

METHODOLOGICAL CONSIDERATIONS

It would be noted that the models used in the analysis here do not explain all of the variance in the outcome. This is likely due to the fact that these models are not saturated—that is to say, they do not take into account all the factors that potentially influence the outcome. Such factors could be unmeasured variables within the underlying causal structure linking exposure and outcome, or confounders of the exposure-outcome relationship (Fewell et al, 2007) Some of these factors have been mentioned in the literature review for this study in chapter 2. Others may be completely unknown. The observational nature of this study makes this especially likely since exposure assignment is not random. The distribution of these unmeasured factors could be uneven between individuals with different exposure statuses—confounding comparisons across exposure categories. This situation is not easily remedied as these confounders may be completely unknown to the researcher. With this in mind, certain approaches could be applied to help understand and ameliorate these issues.

One such approach is the use of instrumental variables, which are unrelated to the outcome directly but affect the outcome through the mediation of the exposure. Perhaps the best example of such a variable is randomization. The use of instrumental variables is hampered by the fact that it is often impossible to determine that the chosen variable does not have any association with the outcome save through exposure as its relationship to the outcome could itself be confounded. This approach was not used in this study as no such variable could be identified.

Another approach would be the use of methods to reduce confounding from known variables. These methods would include propensity score adjustment (Austin, 2011) and inverse probability weighting (Mansournia et al, 2016; Seaman, 2013). While these methods do eliminate confounding from known confounders, they do not achieve a balance of unknown variables across exposure categories and thus do not reduce unknown confounding.

A third approach would be the use of sensitivity analyses (Salteli, 2000) to see what the effect of variation in certain variables not included in the analyses could be. This method could be applied using simulation to model the effect of unmeasured confounders. While more appropriate for this study, the methodological and computational requirements of this approach put it beyond the scope of this study.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

INTRODUCTION

In this chapter, we present the conclusions of this study and discuss the potential policy implications of these findings.

CONCLUSIONS

Based on the findings of this study, we conclude in answering our major research question that the observed variation in district level cumulative fertility is mainly due to compositional rather than contextual effects. The individual level variables accounted for more than 60% of the observed variation in district level cumulative fertility while district level variables accounted for only about 3%. District level variables such as urban/rural residence had a negligible effect on the observed variation. It appears then that, the differences seen between urban and rural fertility are mainly due to the differences in the characteristics of the people living there rather than factors that exist in either context.

A further examination of the individual factors affecting fertility further showed that, while education, wealth, age at first sex and contraception were associated with cumulative fertility, their effects were mediated by interactions with age, which appears to be the major driver of cumulative fertility differentials. Age has a positive non-linear relationship with cumulative fertility with the peak effect observed from ages 24 to 39 years and a flattening of the curve thereafter.

RECOMMENDATIONS

The study findings have important implications for the formulation of future policies aimed at achieving fertility decline in Ghana. The findings of this study suggest that individual characteristics are the most important contributors to any changes in fertility. Thus it is important that any policy aimed at reducing fertility should focus on improving female education and the general socio-economic status of women. Since per the findings of this study, there is very little effect of the district or urban/rural context on fertility, policies and programs tailored to a particular demographic group may be used for similar groups in other places with little modification irrespective of how different the two locations are. This should help improve efficiency in the design and implementation of population-based programs.

In Ghana, the population policy has been largely relegated to the background when it comes to long-term policy planning. However, having achieved significant reductions in mortality in recent times, the country stands poised to reap the economic rewards of the demographic dividend if it is able to significantly reduce its fertility rate. Unfortunately, fertility decline in Ghana appears to have stalled in recent times and new ideas have to be found to stimulate additional fertility declines. (Ashford, 2007; Bloom, Canning, Fink, & Finlay, 2007; R. Eastwood & Lipton, 2011). The findings of this study suggest that, improving the socio-economic status of women will likely reap significant future economic gains. Thus, the government should prioritize initiatives aimed in this direction as part of its long-term economic strategy.

One of the most important challenges faced by Ghana and other African countries is the high rate of internal migration. Much has been written about the development of sprawling urban slums populated by these migrants. (Ackah & Medvedev, 2012; John C Caldwell, 1968) While the economic plight of these migrants regularly gets the attention of policy makers, much less attention has been paid to their reproductive health needs. The findings of this study suggest that this is an issue that deserves more prominence. As these migrant women largely retain the individual characteristics they had as rural dwellers, they still possess the tendency towards high fertility levels, despite being in a low-fertility urban environment. As the Ministries of Interior, Employment and Social Welfare, Health and their associated agencies formulate a response to the problem of internal migration; it is imperative the reproductive health needs of these migrants be taken into consideration as well. The findings of this study also illustrate how important it is for policy makers to factor an understanding of demographic concepts in the planning of social interventions. Programs aimed at extending family planning services to these migrants for example will go a long way to helping reduce their fertility and overall health.

Finally, this study illustrates the application of multilevel modeling to demographic phenomena. As we have seen, this is a very versatile methodology, which could help improve our understanding of the interaction between factors acting at different levels as they influence these phenomena. It makes a very powerful addition to the demographic investigator's toolbox and should be used more often by researchers.

REFERENCES

Abadian, S. (1996). Women's autonomy and its impact on fertility. *World development, 24*(12), 1793-1809.

Ackah, C., & Medvedev, D. (2012). Internal migration in Ghana: determinants and welfare impacts. *International Journal of Social Economics, 39*(10), 764-784.

Addo, N. O. (1987). Population migration and employment: the case of Ghana.

Adongo, P. B., Phillips, J. F., Kajihara, B., Fayorsey, C., Debpuur, C., & Binka, F. N. (1997). Cultural eactors constraining the introduction of family planning among the Kassena-Nankana of Northern Ghana. *Social science & medicine, 45*(12), 1789-1804.

Agyepong, I. A. (1999). Reforming health service delivery at district level in Ghana: the perspective of a district medical officer. *Health Policy and Planning, 14*(1), 5969.

Agyepong, I. A., & Adjei, S. (2008). Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health policy and planning, 23*(2), 150-160.

Ahn, N., & Mira, P. (2002). A note on the changing relationship between fertility and female employment rates in developed countries. *Journal of population Economics, 15*(4), 667-682.

Ainsworth, M., Beegle, K., & Nyamete, A. (1996). The impact of women's schooling on fertility and contraceptive use: A study of fourteen sub-Saharan African countries. *The World Bank Economic Review*, *10*(1), 85-122.

Alene, G. D. W., A. (2008). Differentials of fertility in North and South Gondar zones, northwest Ethiopia: A comparative cross-sectional study. *BMC Public Health, 8*, 397-398.

Anglewicz, P. (2014). *PMA2020: Using mobile technology to establish contraceptive prevalence and method mix in Kinshasa.* Paper presented at the 142nd APHA Annual Meeting and Exposition (November 15-November 19, 2014).

Ashford, L. S. (2007). Africa's youthful population: Risk or opportunity. *Population Reference Bureau, Washington DC*.

Balk, D. (1994). Individual and community aspects of women's status and fertility in rural Bangladesh. *Population Studies, 48*(1), 21-45.

Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food policy, 26*(4), 315-331.

Benefo, K., & Schultz, T. P. (1996). Fertility and child mortality in Cote d'Ivoire and Ghana. *The World Bank Economic Review, 10*(1), 123-158.

Bernhardt, E. M. (1993). Fertility and employment. *European Sociological Review*, *9*(1), 25-42.

Bernstein, H. (1971). Modernization theory and the sociological study of development∗. *The Journal of Development Studies, 7*(2), 141-160.

Bhrolchain, M. N. (1992). Period paramount? A critique of the cohort approach to fertility. *The Population and Development Review*, 599-629.

Blanc, A. K., & Grey, S. (2002). Greater than expected fertility decline in Ghana: untangling a puzzle. *Journal of Biosocial Science, 34*(04), 475-495.

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis.

Blood Jr, R. O., & Wolfe, D. M. (1960). Husbands and wives: The dynamics of married living.

Bloom, D. E., Canning, D., Fink, G., & Finlay, J. (2007). Realizing the demographic dividend: Is Africa any different. *Program on the Global Demography of Aging, Harvard University*.

Bollen, J., & Van de Sompel, H. (2006). *An architecture for the aggregation and analysis of scholarly usage data.* Paper presented at the Proceedings of the 6th ACM/IEEE-CS joint conference on Digital libraries.

Bongaarts, J. (1978). A framework for analyzing the proximate determinants of fertility. *Population and development review*, 105-132.

Bongaarts, J. (1982). The fertility-inhibiting effects of the intermediate fertility variables. *Studies in family planning*, 179-189.

Bongaarts, J. (1993). The supply-demand framework for the determinants of fertility: An alternative implementation. *Population studies, 47*(3), 437-456.

Bongaarts, J. (1994). Population policy options in the developing world. *East Asia, 5*(2.3), 13-75.

Bongaarts, J. (2001). Fertility and reproductive preferences in post-transitional societies. *Population and Development Review*, 260-281.

Bongaarts, J. (2006). The causes of stalling fertility transitions. *Studies in family planning, 37*(1), 1-16.

Bongaarts, J., Frank, O., & Lesthaeghe, R. (1984). The proximate determinants of fertility in sub-Saharan Africa. *Population and Development Review*, 511-537.

Boserup, E. (1985). Economic and demographic interrelationships in sub-Saharan Africa. *Population and Development Review*, 383-397.

Bryant, J. (2007). Theories of fertility decline and the evidence from development indicators. *Population and development review, 33*(1), 101-127.

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: applications and data analysis methods*: Sage Publications, Inc.

Bulatao, R. A., & Lee, R. D. (1983). An overview of fertility determinants in developing countries.

Bumpass, L. (1969). Age at marriage as a variable in socio-economic differentials in fertility. *Demography, 6*(1), 45-54.

Bumpass, L., & Westoff, C. F. (1969). The prediction of completed fertility. *Demography, 6*(4), 445-454.

Byerlee, D. (1974). Rural-urban migration in Africa: Theory, policy and research implications. *International Migration Review*, 543-566.

Cain, M. (1984). *Women's Status and Fertility in Developing Countries: Son Preference and Economic Security. World Bank Staff Working Papers No. 682 and Population and Development Series No. 7*: ERIC.

Caldwell, J. C. (1968). Determinants of rural-urban migration in Ghana. *Population Studies, 22*(3), 361-377.

Caldwell, J. C. (1979). Education as a factor in mortality decline an examination of Nigerian data. *Population studies*, 395-413.

Caldwell, J. C., & Caldwell, P. (1987). The cultural context of high fertility in subSaharan Africa. *Population and development review*, 409-437.

Caldwell, J. C., Orubuloye, I. O., & Caldwell, P. (1992). Fertility decline in Africa: A new type of transition? *Population and development review*, 211-242.

Campbell, A. A. (1983). Manual of fertility analysis.

Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., et al. (2006). Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and society, 11*(2), 8.

Casterline, J. B. (2001). Diffusion processes and fertility transition: Introduction. *Diffusion Processes and Fertility Transition*, 1-38.

Chamie, J. (1981). *Religion and fertility: Arab christian-muslim differentials*: CUP Archive.

Chuks, J. (2002). Ghana's reproductive revolution: analysis of the determinants of fertility transition.

Cleland, J., & Hobcraft, J. (1985). *Reproductive change in developing countries: insights from the world fertility survey*: Oxford University Press.

Cleland, J., Onuoha, N., & Timaeus, I. (1994). Fertility change in sub-Saharan Africa: a review of the evidence. *The onset of fertility transition in Sub-Saharan Africa*, 120.

Cleland, J., & Scott, C. (1987). *The world fertility survey: an assessment*: Oxford University Press.

Cooper, J. (1991). The divergence between period and cohort measures of fertility. *Population Trends*(63), 19-21.

Curtin, R. T., Juster, T., & Morgan, J. N. (1989). Survey estimates of wealth: An assessment of quality *The measurement of saving, investment, and wealth* (pp. 473-552): University of Chicago Press, 1989.

Davis, K., & Blake, J. (1956). Social structure and fertility: An analytic framework. *Economic development and cultural change*, 211-235.

De Onis, M., Onyango, A. W., Borghi, E., Garza, C., & Yang, H. (2006). Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. *Public health nutrition, 9*(07), 942-947.

DiPrete, T. A., & Forristal, J. D. (1994). Multilevel models: methods and substance. *Annual Review of Sociology*, 331-357.

Duncan, C., Jones, K., & Moon, G. (1998). Context, composition and heterogeneity: using multilevel models in health research. *Social science & medicine*, *46*(1), 97117.

Easterlin, R. A. (1975). An economic framework for fertility analysis. *Studies in family planning*, 54-63.

Easterlin, R. A., & Crimmins, E. M. (1985). *The fertility revolution: A supply-demand analysis*: University of Chicago Press.

Eastwood, J. B., Conroy, R. E., Naicker, S., West, P. A., Tutt, R. C., & Plange-Rhule, J. (2005). Loss of health professionals from sub-Saharan Africa: the pivotal role of the UK. *The Lancet, 365*(9474), 1893-1900.

Eastwood, R., & Lipton, M. (2011). Demographic transition in sub-Saharan Africa: How big will the economic dividend be? *Population studies, 65*(1), 9-35.

Fields, G. S. (1975). Rural-urban migration, urban unemployment and underemployment, and job-search activity in LDCs. *Journal of development economics, 2*(2), 165187.

Gaisie, S. K. (1984). The proximate determinants of fertility in Ghana.

Garenne, M. M. (2008). Fertility changes in Sub-Saharan Africa.

Gertler, P. J., & Molyneaux, J. W. (1994). How economic development and family planning programs combined to reduce Indonesian fertility. *Demography, 31*(1), 33-63.

Ghana Statistical Service. (2012). *2010 POPULATION & HOUSING CENSUS*

SUMMARY REPORT OF FINAL RESULTS. Retrieved from http://www.statsghana.gov.gh/pop_stats.html.

Ghana. Statistical, S., Noguchi Memorial Institute for Medical, R., & MEASURE/DHS,

O. R. C. M. (2004). *Ghana demographic and health survey, 2003*: Ghana Statistical Service.

Gilson, L., & Mills, A. (1995). Health sector reforms in sub-Saharan Africa: lessons of the last 10 years. *Health policy, 32*(1), 215-243.

Goldstein, H. (2011). *Multilevel statistical models* (Vol. 922): John Wiley & Sons.

Gss, G. H. S., & Macro, I. C. F. (2009). Ghana demographic and health survey 2008. *Accra, Ghana: Ghana Statistical Service, Ghana Health Service, and ICF Macro*.

Guilmoto, C. Z., & Rajan, S. I. (2001). Spatial patterns of fertility transition in Indian districts. *Population and development review, 27*(4), 713-738.

Gyimah-Boadi, E. (2009). Another step forward for Ghana. *Journal of Democracy, 20*(2), 138-152.

Hatti, N., & Ohlsson, R. (1985). Impact of education on age at marriage. *Demography India, 14*(2), 159-173.

Hermalin, A. I. (1986). *The multi-level approach: Theory and concepts*: Population Studies Center, University of Michigan Ann Arbor.

Hirschman, C. (1994). Why fertility changes. *Annual review of sociology*, 203-233.

Hobcraft, J., & Little, R. J. A. (1984). Fertility exposure analysis: A new method for assessing the contribution of proximate determinants to fertility differentials. *Population Studies, 38*(1), 21-45.

Hofferth, S. L., & Moore, K. A. (1979). Womens employment and marriage.

Imhoff, E., & Keilman, N. (2000). On the quantum and tempo of fertility: Comment. *Population and development review, 26*(3), 549-553.

Juster, F. T., Smith, J. P., & Stafford, F. (1999). The measurement and structure of household wealth. *Labour Economics, 6*(2), 253-275.

Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment. *Development and change, 30*(3), 435-464.

Kaufman, J. S. (2008). Commentary: Why are we biased against bias? *Int J Epidemiol, 37*(3), 624-626.

Kaufman, J. S., Alonso, F. T., & Pino, P. (2008). Multi-level modeling of social factors and preterm delivery in Santiago de Chile. *BMC Pregnancy Childbirth, 8*, 46.

Kennickell, A. B. (2000). Wealth measurement in the Survey of Consumer Finances: Methodology and directions for future research.

Khan, S., Mishra, V., Arnold, F., & Abderrahim, N. (2007). Contraceptive trends in developing countries.

Kim, D., Subramanian, S. V., & Kawachi, I. (2006). Bonding versus bridging social capital and their associations with self rated health: a multilevel analysis of 40 US communities. *Journal of Epidemiology and Community Health*, *60*(2), 116-122.

Klein, K. J., & Kozlowski, S. W. J. (2000). *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions*: Jossey-Bass.

Koranteng, R. O., & Larbi, G. A. (2008). Policy networks, politics and decentralisation policies in Ghana. *Public Administration and Development*, *28*(3), 212-222.

Kravdal, Ø. (2002). Education and fertility in sub-Saharan Africa: Individual and community effects. *Demography*, *39*(2), 233-250.

Kreft, I. G. G., Kreft, I., & de Leeuw, J. (1998). *Introducing multilevel modeling*: Sage.

Kropp, D. (2013). *Languages Of Ghana*: Taylor & Francis.

Kwamina, B. D., & Benneh, G. (1977). *A new geography of Ghana*: Longman.

Lavy, V., Strauss, J., Thomas, D., & De Vreyer, P. (1996). Quality of health care, survival and health outcomes in Ghana. *Journal of health economics*, *15*(3), 333-357.

Lee, B. S. L., G. P. . (1993). The Influence of Rural-Urban Migration on Migrant's Fertility in Korea, Mexico and Cameroon. *Population and Development Review*, *12*, 3-26

Lehrer, E. L. (1996). Religion as a determinant of marital fertility. *Journal of Population Economics*, *9*(2), 173-196.

Lloyd, C. B., & Gage-Brandon, A. J. (1994). High fertility and children's schooling in Ghana: Sex differences in parental contributions and educational outcomes. *Population Studies*, *48*(2), 293-306.

Mahapatra, P., Shibuya, K., Lopez, A. D., Coullare, F., Notzon, F. C., Rao, C., et al. (2007). Civil registration systems and vital statistics: successes and missed opportunities. *The Lancet*, *370*(9599), 1653-1663.

Malhotra, A. (1997). Gender and the timing of marriage: Rural-urban differences in Java. *Journal of Marriage and the Family*, 434-450.

Mboup, G. T., S. . (1998). Calverton, MD: Macro International.

McQuillan, K. (2004). When does religion influence fertility? *Population and Development Review*, *30*(1), 25-56.

Mensah-Kumah, O. (1986). Family planning communication in Ghana: retrospect and prospect.

Mock, C. N., & Maier, R. V. (1997). Low utilization of formal medical services by injured persons in a developing nation: health service data underestimate the importance of trauma. *Journal of Trauma and Acute Care Surgery, 42*(3), 504513.

Morhee, R. A. S., & Morhee, E. S. K. (2006). Overview of the law and availability of abortion services in Ghana. *Ghana Medical Journal, 40*(3).

Morris, S. S., Black, R. E., & Tomaskovic, L. (2003). Predicting the distribution of underfive deaths by cause in countries without adequate vital registration systems. *International Journal of Epidemiology, 32*(6), 1041-1051.

Muhuri, P. K. B., A. K. ; Rutstein, S. O. (1994). Socioeconomic Differentials in Fertility.

National Population Council, G. (1994). *National Population Policy, 1994.*

Naudé, W. (2013). Development Progress in sub-Saharan Africa: Lessons from Botswana, Ghana, Mauritius and South Africa. *Achieving Development Success: Strategies and Lessons from the Developing World*, 284-292.

Nukunya, G. K. (2003). *Tradition and change in Ghana: An introduction to sociology*: Ghana Universities Press.

Nyonator, F. K., Awoonor-Williams, J. K., Phillips, J. F., Jones, T. C., & Miller, R. A. (2005). The Ghana community-based health planning and services initiative for scaling up service delivery innovation. *Health policy and planning, 20*(1), 25-34.

Obeng, L. (1977). Should dams be built? The Volta Lake example. *Ambio*, 46-50.

Okonofua, F. E., Harris, D., Odebiyi, A., Kane, T., & Snow, R. C. (1997). The social meaning of infertility in Southwest Nigeria. *Health Transition Review*, 205-220.

Petr, T. (1986). The Volta river system *The ecology of river systems* (pp. 163-199): Springer.

PMA2020. (2013). PMA 2013 Ghana Brief.

Preston, S., Heuveline, P., & Guillot, M. (2000). Demography: measuring and modeling population processes.

Pritchett, L. H. (1994). Desired fertility and the impact of population policies. *Population and Development Review*, 1-55.

Ravenholt, R. T. WORLD FERTILITY SURVEY.

Robinson, W. C. (1997). The economic theory of fertility over three decades. *Population studies, 51*(1), 63-74.

Rodriguez, G., & Cleland, J. (1980). Socio-economic determinants of marital fertility in twenty countries: a multivariate analysis.

Rosenzweig, M. R., & Schultz, T. P. (1985). The demand for and supply of births: Fertility and its life cycle consequences. *The American Economic Review*, 9921015.

Ryder, N. B. (1982). Progressive fertility analysis.

Ryder, N. B. (1983). Cohort and period measures of changing fertility.

Sahn, D. E., & Stifel, D. C. (2003). Urban–rural inequality in living standards in Africa. *Journal of African Economies, 12*(4), 564-597.

Salomon, J. A., Wang, H., Freeman, M. K., Vos, T., Flaxman, A. D., Lopez, A. D., et al. (2013). Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. *The Lancet, 380*(9859), 21442162.

Sattar, M. A. Measures of fertility.

Sedgh, G. (2010). Abortion in Ghana. *Issues in brief (Alan Guttmacher Institute)*(2), 1-4.

Setel, P. W., Sankoh, O., Rao, C., Velkoff, V. A., Mathers, C., Gonghuan, Y., et al. (2005). Sample registration of vital events with verbal autopsy: a renewed commitment to measuring and monitoring vital statistics. *Bulletin of the World Health Organization*, *83*(8), 611-617.

Shapiro, D., & Gebreselassie, T. (2009). Fertility transition in sub-Saharan Africa: falling and stalling.

Singh, S., & Casterline, J. (1985). The socio-economic determinants of fertility.

Smith, D. P. (1992). Measures of Fertility *Formal Demography* (pp. 221-253): Springer.

Smith, L. C., & Haddad, L. J. (2000). *Explaining child malnutrition in developing countries: A cross-country analysis* (Vol. 111): Intl Food Policy Res Inst.

Smith, L. C., Ruel, M. T., & Ndiaye, A. (2005). Why is child malnutrition lower in urban than in rural areas? Evidence from 36 developing countries. *World Development, 33*(8), 1285-1305.

Snijders, T. A. B. (2011). *Multilevel analysis*: Springer.

Sorenson, A. M. (1989). Husbands' and wives' characteristics and fertility decisions: A diagonal mobility model. *Demography*, *26*(1), 125-135.

Steele, F., Amin, S., & Naved, R. T. (1998). *The impact of an integrated micro-credit program on women's empowerment and fertility behavior in rural Bangladesh*: Population Council, Policy Research Division.

Subramanian, S. V., Jones, K., & Duncan, C. (2003). *Multilevel methods for public health research*: Neighborhoods and health. New York: Oxford University Press.

Takyi, B. K. (1993). The status of women and fertility behavior in Sub-Saharan Africa: the effects of female labor force participation and gender preferences on fertility in Ghana.

Takyi, B. K., Gyimah, S. O., & Addai, I. (2006). *Religion and fertility behavior of married men and women: an empirical examination of data from Ghana subSaharan Africa*.

Tawiah, E. O. (1997). Factors affecting contraceptive use in Ghana. *Journal of Biosocial Science, 29*(02), 141-149.

Tipps, D. C. (1973). Modernization theory and the comparative study of national societies: A critical perspective. *Comparative Studies in Society and History, 15*(02), 199-226.

Turner, M. G., O'Neill, R. V., Gardner, R. H., & Milne, B. T. (1989). Effects of changing spatial scale on the analysis of landscape pattern. *Landscape ecology, 3*(3-4), 153162.

Van de Walle, E. (1968). Marriage in African censuses and inquiries.

Van Imhoff, E. (2001). On the impossibility of inferring cohort fertility measures from period fertility measures. *Demographic Research, 5*(2), 23-64.

Wejnert, B. (2002). Integrating models of diffusion of innovations: A conceptual framework. *Annual review of sociology*, 297-326.

Westoff, C. F., Charles, F., & Bankole, A. (1999). Demographic and Health Surveys.

White, M. J., Muhidin, S., Andrzejewski, C., Tagoe, E., Knight, R., & Reed, H. (2008). Urbanization and fertility: An event-history analysis of coastal Ghana. *Demography, 45*(4), 803-816.

Witter, S., & Garshong, B. (2009). Something old or something new? Social health insurance in Ghana. *BMC International Health and Human Rights, 9*(1), 20.

Wong, G. Y., & Mason, W. M. (1985). The hierarchical logistic regression model for multilevel analysis. *Journal of the American Statistical Association, 80*(391), 513524.

Wood, J. W. (1989). Fecundity and natural fertility in humans. *Oxford reviews of reproductive biology, 11*, 61-109.

World Health, O. (2010). *World health statistics 2010*: World Health Organization.

Yabiku, S. T. (2005). The effect of non-family experiences on age of marriage in a setting of rapid social change. *Population Studies, 59*(3), 339-354.

Zaba, B., Pisani, E., Slaymaker, E., & Boerma, J. T. (2004). Age at first sex: understanding recent trends in African demographic surveys. *Sexually transmitted infections, 80*(suppl 2), ii28-ii35.

Zhang, Y. (2006). Urban‐Rural Literacy Gaps in Sub‐Saharan Africa: The Roles of Socioeconomic Status and School Quality. *Comparative Education Review, 50*(4), 581-602.

APPENDIX: DATA CAPTURE TOOL

BACKGROUND VARIABLES

1. Observation ID ……………………….
2. Eligible female? Y/N (note: if N, none of the following questions should be answered)
3. Household ID ……………………….
4. Locality ID ……………………….
5. Region ID ……………………….
6. District ID ……………………….
7. Residence: Rural/Urban

DEMOGRAPHIC VARIABLES

8. Age (Years) ……………………….
9. Age category (calculated from above.)
    a. 15-19
    b. 20-24
    c. 25-29
    d. 30-34
    e. 35-39

f. 40-44

g. 45-49

10. Marital status

a. Never married

b. Currently married

c. Separated

d. Divorced

11. Wealth index value ……………………….

12. Education

a. None

b. Primary

c. Junior High School

d. Senior High School

e. Tertiary

FERTILTY AND CONTRACEPTION VARIABLES

13. Number of children alive ……………………….

14. Total births ……………………….

15. Past use of Family planning? Y/N

16. Age at first sex ……………………….