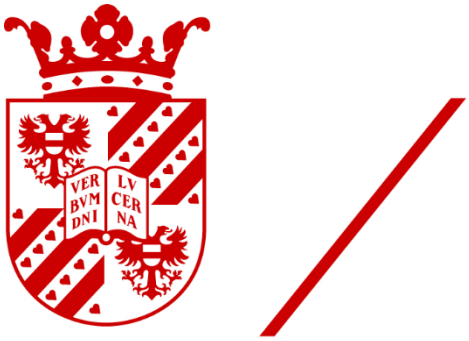
DIFFERENCES IN FERTILITY BETWEEN RURAL AND URBAN NIGERIA



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Abstract

This research has attempted to find out why rural fertility rates are substantially higher than those in urban regions of Nigeria. Little contemporary work has been written on rural versus urban fertility differentials in Nigeria. Lowering the Total Fertility Rate (TFR), especially in rural areas, is key in limiting the immense population growth Nigeria is projected to go through. The Demographic & Health Survey (DHS), a cross-sectional survey on health and demographic indicators, was used to test key determinants by method of quantitative statistical analysis. The theoretical framework has identified a number of background determinants of fertility in Sub-Saharan Africa (SSA) and how these determinants differ between rural and urban areas. These have been tested with Poisson regression. It was found that the chosen background determinants account for a large portion of the difference between rural and urban fertility, although a small difference remains. The difference going from 31.4% (in 2008), 35.5% (in 2013) and 35% (in 2018) to 4%, 5.4% and 6.4% respectively, when accounting for differences in the background determinants. Differences in educational level and wealth are especially important for the difference in fertility between rural and urban Nigeria. To a lesser extent, child mortality and religion also contribute to the difference.

Keywords: Fertility, Nigeria, Rural, Urban, Differences, Education level, Child mortality, Religion, Women empowerment, Wealth.

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List of Abbreviations

DHS	Demographic & Health Survey
IRR	Incidence Rate Ratio
TFR	Total Fertility Rate
SSA	Sub-Saharan Africa
VWBI	Views on Wife Beating Index
VSRI	Views on Sex Refusal Index

1. Introduction

As developing countries all over the world have experienced positive socioeconomic developments, Total Fertility Rate (TFR), which is the number of children a woman is expected to have over her lifetime, has gone down as well (Bongaarts, 2017). This is in line with the Demographic Transition Theory, which suggests that fertility goes down as countries become more developed (i.e. rise in primary education, GDP per capita, life expectancy and urbanization) (IUSSP, 2019). Africa's fertility transition has started in 1980, which is later than other developing countries, that started to experience the transition in the 1960's (Van Wissen & Van der Gaag, 2019). Although Africa is experiencing the fertility transition, the rate at which this process is happening is relatively slow. Because of this, fertility remains high in Sub-Saharan Africa (SSA), while TFR has gone down substantially in other developing regions (e.g. Asia and Latin America) (Bongaarts, 2017). While fertility in Latin America and Asia have reached a level of a little more than 2 children per woman, Africa's TFR is still at around 4.5 (UN, 2020). Although Africa's replacement level (i.e. fertility needed to keep the population the same size) is higher than in the rest of the world, due to higher (child) mortality rates, it is nowhere near 4.5 children per woman (Espenshade et al., 2003).

The persistence of high levels of fertility in SSA will have substantial effects on future population change. UN predictions expect the population of SSA to change from 0.8 billion to between 2.9 and 5.5 billion between 2010 and 2100 (Bongaarts, 2017), depending on different expectations in fertility decline. Nigeria is expected to contribute most to this growth. The nation still has a TFR of 5.3, which is an increase from its TFR in 2015 (5.0) (DHS, 2020a). Nigeria is expected to increase with 200 million people between 2019 and 2050 (UN, 2019), which is the second highest growth out of all countries in the world. This is the main reason why this research focusses on Nigeria, as this huge population increase will likely bring many social, economic and environmental problems with it.

When looking at Demographic & Health Survey (DHS) data (2020a) on fertility in Nigeria, a difference is visible in fertility between place of residence (i.e. rural or urban residence). In 2018, the TFR for rural residents was 5.9, while in urban areas this value was 4.5. Which means, on average, there is still a difference of 1.4 births per woman between rural and urban areas of Nigeria. This notion is often confirmed in the literature for SSA (Dodoo & Tempenis, 2002; Garenne & Joseph, 2002; Shapiro & Gebreselassie, 2008; Shapiro & Tenikue, 2017). Garanne & Joseph (2002) stated that the fertility transition is distinctly stronger in urban areas than in rural areas. This could indicate that the persisting high fertility rates in SSA are mainly a rural issue. No recent in-depth research has been done to look at what determines the differences between rural and urban women with regard to

fertility in Nigeria.

The objective of this research is to find out what factors are important in determining the difference in rural and urban fertility in Nigeria. Knowledge on the cause of this difference can help to find focus to create more effective policies to reduce fertility rates in rural areas of Nigeria, as the country's population policies of 1988 and 2004 have not accomplished the desired results (Michael & Odeyemi, 2017). New effective policies targeting rural areas, will be an important step in lowering the nation's population growth.

2. Theoretical Framework

2.1. Theory

Two theories are key in understanding the process of fertility change. The Demographic Transition Theory explains the general development processes fertility is subjected to over time (IUSSP, 2019). Bongaarts Fertility Theory makes an important distinction between two types of determinants that influence fertility (Bongaarts, 1978; Bongaarts et al., 1984; Bongaarts, 2015).

2.1.1. Demographic Transition Theory

One of the most central theories in demography is the Demographic Transition Theory. The theory aims to explain changes in population size and composition. The theory was first formulated by Notestein in 1944 (Kirk, 1996) and has developed since then. Although the theory is a generalized view of demographic change, it is still important in understanding global population change today (IUSSP, 2019).

The theory states that low socio-economic development leads to a higher demand for children (Bongaarts, & Casterline, 2013). High child mortality causes a desire for even more children in order to replace losses or anticipate for future losses, as more children mean more help in labor and more security at older ages (Bongaarts, & Casterline, 2013).

According to the theory, there are multiple demographic stages a country goes through, driven by socio-economic and other developments (IUSSP, 2019) (Figure 1). Stage one is the pre-transition stage, which is characterized by high and fluctuating birth and death rates. The second stage is called the early transition stage. In this stage mortality rates start to go down, while fertility rates stay high. Massive population growth is the result of this stage. The third stage is the late transition stage. As birth rates start to decline, population growth starts to slow down. The post-transition stage is characterized by a stable and low rate for both fertility and mortality. Population is stable or might even decline in this stage.

As said before, the model is a generalization and all countries follow the stages differently with regards to timing, speed and size of the different rates (IUSSP, 2019). According to the definition of the different phases that have been discussed, Nigeria is still at the end of the second stage, as TFR is not decreasing rapidly. Going from this stage to the fourth stage is essentially the challenge the country faces.

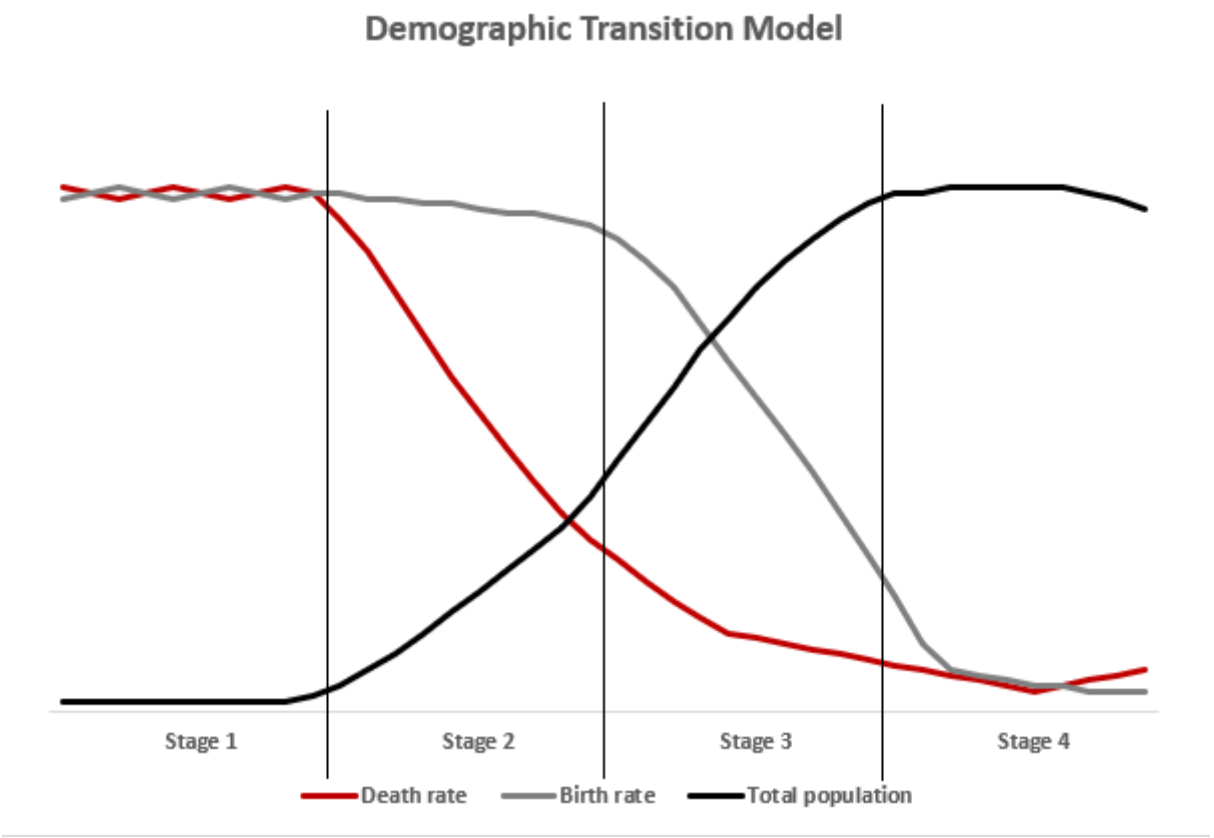


Figure 1. The Demographic Transition Model (IUSSP, 2019)

2.1.2. Bongaarts determinants of fertility theory

In the literature, an important distinction is made between determinants of fertility (Bongaarts, 1978; Bongaarts et al., 1984; Bongaarts, 2015). This theory makes a distinction between background and proximate determinants. It is suggested that fertility is not directly affected by the social, economic, environmental and cultural factors called the background determinants. Instead, these factors influence the proximate determinants that, in turn, influence fertility (Figure 2). Bongaarts (2015) provides an updated model of proximate determinants to fit into contemporary society. The updated proximate determinants are:

- *Being married or in a sexual union*
- *Age of marriage*
- *Extramarital sexual exposure:* Being sexually active, without being married.
- *Contraceptive prevalence:* Does an individual use contraception?
- *Contraceptive effectiveness:* Effectiveness of the contraceptive method.

- *Infecundability:* When a woman is not able to have a child due to age, disease, being pregnant, being in the infecund period after giving birth (postpartum amenorrhea) or any other reason.
- *Abortion:* Does a woman use abortion methods when becoming pregnant unwanted?

As an example of how a background determinant influences fertility; an educated woman (background characteristic) has more knowledge of contraceptive use and uses it more frequently (proximate determinant), leading to a lower number of births.

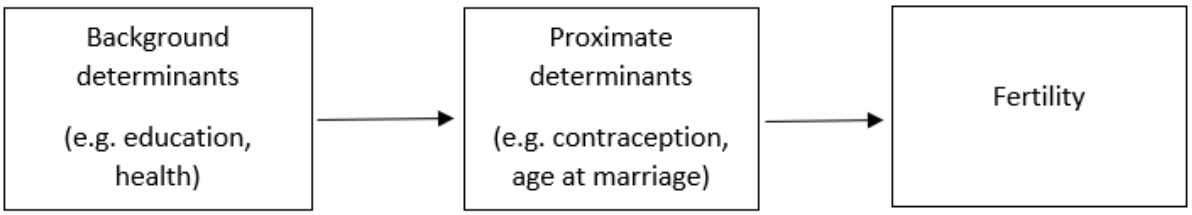


Figure 2. The model of proximate and background determinants (Bongaarts et al.l, 1984).

The two theories mentioned, help to create an understanding of the process of fertility and population change. They also help to get an idea of how different determinants could be related to the process. The next step will be to identify relevant determinants.

2.2. Literature review

Recent literature about the determinants for high rural fertility in Nigeria is scarce. However, a large amount of literature has been written about the high fertility levels in SSA. The most important indicators mentioned will be tested to determine their effects on the difference between urban and rural fertility. A small amount of literature already exists that studies part of difference between rural and urban fertility in SSA as well. The factors mentioned to be related to the difference, will be included in this research. Only relatively recent literature will be discussed (from about 2000) to prevent outdated results to paint a wrong picture of contemporary fertility in the region.

2.2.1. Fertility in Sub-Saharan Africa

Many existing studies have tried to explain the fertility patterns of SSA. Bongaarts (2017) stated that SSA's high fertility can be explained by a variety of factors. The first reason is that SSA's fertility

transition started later than other regions in the world. SSA's transition only started in the 1980's, compared to 1960 for most other developing regions, which means fertility has had less time to decline.

Another factor Bongaarts (2017) mentioned as a reason for persistence of high fertility in SSA, is the fact that development indicators (i.e. education, GDP per capita, life expectancy & urban population) did not improve as fast as they did in other developing regions (e.g. Asia and Latin America). In accordance with Demographic Transition Theory, this means fertility will remain high. Bongaarts (2017) considers urbanization a development indicator, which is likely because urban individuals often score higher on average on the other development indicators than rural people.

Most literature has agreed that a basic education for women is one of the most important factors for lowering fertility (Hogan et al., 1999; Shapiro & Gebreselassie, 2008; Bongaarts, 2010; Shapiro & Tenikue, 2017; Eloundou-Enyegue et al., 2017). The higher education level gets, the less children an individual is expected to have. Multiple explanations are proposed for this phenomenon. First of all, higher education of women leads them to have higher educated children as well (Shapiro & Tambashe 2003). According to the quality-quantity tradeoff, this leads them to have less children (Shapiro & Tenikue, 2017). Secondly, higher educated women have shorter periods in which they can conceive children, due to later marriage (Shapiro & Gebreselassie, 2008; Bongaarts, 2010; Shapiro and Gebreselassie 2014). Higher educated women also use more contraception (Shapiro & Gebreselassie, 2008; Bongaarts, 2010). Lastly, Rostein (2000) has found a negative relation between education level and child mortality. Child mortality, in turn, has a positive relationship with fertility. In contrast, Garanne & Joseph (2002) mention in their article that there was no clear relationship between growing education levels and the start of the fertility decline in many countries of SSA.

Literature on the effect of income on fertility is divided. According to demographic transition theory (IUSSP, 2019) and Bongaarts (2017), the effect of income on fertility is negative, because more children mean more financial security for people with lower incomes. However, Garanne & Joseph (2002) found no significant relationship between income and fertility. Shapiro & Gebreselassie (2008) even found that GDP growth causes fertility decline to slow down. Eloundou-Enyegue et al. (2000), suggested that this might be due to crisis led fertility decline. Meaning that economic downturn leads individuals to terminate childbearing entirely or postpone their next birth until the economic crisis is over. Thus, economic growth leading to higher fertility.

Another factor that is mentioned as important, is child and infant mortality (Shapiro & Gebreselassie, 2008; Shapiro & Tenikue, 2017; Michael & Odeyemi, 2017). High child mortality leads to high birth rates. This process works in two ways (Benefo & Schultz, 1996). First, individuals may have children to replace the children that have passed away. Secondly, people often plan for more children in anticipation of the child mortality they expect to experience.

Bongaarts (2017) proposed that even when controlling for these development indicators, SSA's fertility is higher than other regions. This is called the 'Africa effect', which is caused by SSA pronatalist culture. This results in low prevalence of contraception and a bigger desired family size. Some cultural groups in SSA seem to show substantially higher fertility than others. Literature most often mentions that Islamic and traditionalist groups tend to show behavior that causes higher fertility (e.g. lower contraceptive use or rewarding high fertility) than other religious groups (Shapiro & Gebreselassie, 2014; Westoff & Bietsch, 2015; Hogan et al., 1999; Michael & Odeyemi, 2017).

Undesired fertility is another component of the issue. Spacing between children is of high importance in SSA, which means contraception between births is an important (unmet) need (Rafalitnanana & Westoff, 2000). Singh et al. (2017) confirm that actual fertility exceeds desired fertility in SSA. Non-use of modern contraception is the main driver for the high number of unintended births. Guengant & May (2001) agree with this statement and argue that a switch to a modern mix of contraception is of vital importance in lowering SSA's fertility.

Another factor mentioned in the literature to be a vital determinant influencing fertility in SSA is women empowerment (Hogan et al., 1999; Woldemicael, 2009; Upadhyay & Karasek, 2012). Women empowerment can be measured by a woman's decision-making power on day to day tasks (e.g. purchases), their views on wife beating and their power on direct decisions on conceiving a child (Woldemicael, 2009; Upadhyay & Karasek, 2012). Phan (2015) argues that education level and employment status, are also important in empowering women. When women are not able to express their fertility preferences due to power differences between them and their husbands, they have more children than desired (Hogan et al., 1999). Empowered women, on the other hand, are likely to desire less children and use contraceptive methods more often.

One important note mentioned in most literature on fertility in SSA, is the fact that SSA is by no means a homogenous region. Cultural, social and economic differences mean that there could be different reasons for high fertility within SSA. High fertility is also more common in middle and west SSA, than in the east or the south (Casterline & Agyei-Mensah, 2017; Guengant & May, 2001). This means we have to be aware of the risk of generalization when talking about the entire region of SSA.

That being said, most causes for high fertility in Nigeria are expected to be the same as those for SSA. Just like for SSA contraceptive prevalence, education level of women, mortality rates and Nigeria's sociocultural characteristics are mentioned as key factors in determining its fertility levels (Osili & Long, 2008; Michael & Odeyemi, 2017). Different ethnic groups in Nigeria have different fertility behavior. Especially the more rural ethnic groups in the north-east and north-west have big desired family sizes due to their cultural beliefs (Michael & Odeyemi, 2017). According to Stonawski (2016), Muslims show higher fertility in Nigeria and they, indeed, live mostly in the northern areas of the country. Traditional religions also reward high fertility in Nigeria (Michael & Odeyemi, 2017).

2.2.2. Differences between rural and urban fertility

The factors that cause rural fertility to be higher than urban fertility are largely the same as those that keep SSA's fertility high in general. The fertility transition occurred earlier in urban areas as opposed to rural areas in almost all of SSA's nations (Garenne & Joseph, 2002). The difference in onset of the transition is about a decade in most countries.

Furthermore, contraceptive services are more accessible in cities, which is another reason urban fertility is lower (Garenne & Joseph, 2002; Shapiro, & Tambashe, 1999). Shapiro & Gebreselassie (2008) confirm that urban residents more often use modern contraceptive methods. In the rural setting, individuals must often travel over large distances to be able to get access to modern contraceptive methods (Dodoo & Tempenis, 2002).

Modern health services in the city also mean that there is a significant difference in infant and child mortality between rural and urban regions (Shapiro & Gebreselassie, 2008). Urban residents experience significantly lower child and infant mortality rates (Shapiro, & Tambashe, 1999), which leads to lower fertility rates in the city.

Education level is mentioned as an important determinant for rural and urban fertility differences in literature (Hogan et al., 1999; Shapiro, & Tambashe, 1999; Ushie et al., 2011; Shapiro & Gebreselassie, 2008), with a larger component of primary, secondary and higher educated individuals in cities leading to a lower amount of births.

Age of entry into marital union is also mentioned in the literature as an important determinant for urban and rural fertility differences. The fact that women marry at younger ages in rural areas, causes their fertility to be higher over their lifetime (Ushie et al., 2011). However, not only age at marriage is relevant. The fact that a smaller component of urban inhabitants is married, is also a contributing factor to lower urban fertility levels (Shapiro & Gebreselassie, 2008; Shapiro, & Tambashe, 1999). However, it is likely that the reason for the lower percentage of married people in cities is largely due to the fact that its inhabitants marry later.

The role of women also differs between rural and urban areas (Hogan et al., 1999; Dodoo & Tempenis, 2002). Men often still make the decisions in rural SSA regarding things like usage of contraceptive methods. This leads to higher fertility rates, as men are often more pronatalist (Dodoo & Tempenis, 2002). Hogan et al. (1999) go as far as calling women's status the most significant force by far in lowering fertility in rural Ethiopia. It must be mentioned, however, that their article considers a basic education level as a part of women's status. They consider employment status as another indicator for women's status.

Ushie et al. (2011) stated that differences in religious practices and cultures between rural and urban areas of the cross-river state in Nigeria lead to earlier marriage in the rural areas. As stated before, this leads to higher lifetime fertility. Stonawski et al. (2016), who have concluded that Muslims show higher fertility in Nigeria, also show that, generally, the biggest population of Muslims live in the more rural northern part of the country.

2.3. Conceptual model

This research investigates which micro-level background determinants of individuals influence rural and urban fertility in Nigeria. From the theory and literature review sections, important indicators are identified. Development indicators (education level, income, child mortality) and woman empowerment are expected to be negatively related to fertility. Religion is added to the model to try to capture the effect of culture, which Bongaarts (2017) mentioned as the cause of the Africa-effect. Although proximate determinants (e.g. contraceptive use and age at marriage) have their role in determining fertility, focus will be on the background determinants. As change in the background determinants, will also influence the proximate determinants (Bongaarts, 1978; Bongaarts et al., 1984; Bongaarts, 2015). The proximate determinants will be discussed in the discussion, as they are essential in creating a complete understanding of the whole picture of fertility in Nigeria. The model is limited to the determinants that are measurable in the DHS.

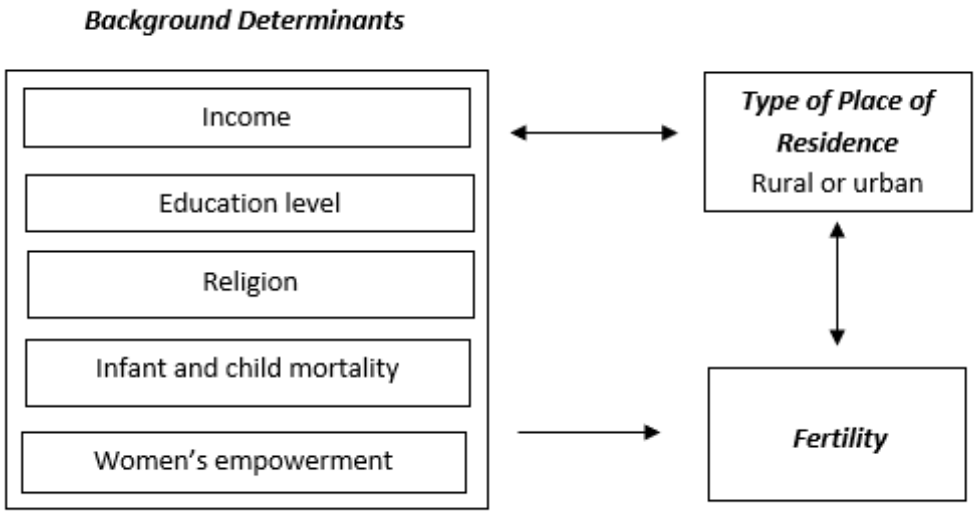


Figure 3. Conceptual Model

2.4. Research Questions & Hypotheses

The aim of this article is to see what determines the difference between rural and urban fertility. The literature and theories have helped to create appropriate research questions. The main question is:

- Which determinants are related to the differences between rural and urban fertility in Nigeria?

The main question will be divided into a number of sub-questions:

- To what extent are differences in child mortality related to the difference between rural and urban fertility in Nigeria?
- To what extent is women empowerment related to difference between rural and urban fertility in Nigeria?
- To what extent are differences in education level related to the difference between rural and urban fertility in Nigeria?
- To what extent are differences in income related to the difference between rural and urban fertility in Nigeria?
- To what extent are differences in religion related to the difference between rural and urban fertility in Nigeria?

Literature has also suggested what relationship is to be expected between the background determinants and urban and rural fertility. One main hypothesis (i.e. hypothesis 1) and a number of sub-hypotheses can be stated. The sub-hypotheses are divided in two parts. The hypotheses about how the different determinants are related to type of place of residence and the hypotheses that state in what way the variables determine the difference between urban and rural fertility levels.

1. Higher fertility levels in rural compared to urban Nigeria can be explained by compositional differences in the population regarding the background determinants between these two types of residences.
2. Rural areas have higher child and infant mortality than urban areas of Nigeria.
3. In rural areas woman are less empowered than those in urban areas of Nigeria.
4. Rural areas have a lower average education level than urban areas of Nigeria.
5. Rural areas have a lower income per capita than urban areas of Nigeria.
6. Rural areas have a bigger component of Muslim and Traditionalist women than urban areas of Nigeria.

7. Higher fertility levels of rural Nigeria can partly be explained by higher infant and child mortality levels.
8. Higher fertility levels of rural Nigeria can partly be explained by lower empowerment for women in the area.
9. Higher fertility levels of rural Nigeria can partly be explained by lower average education levels.
10. Higher fertility levels of rural Nigeria can partly be explained by lower average income per capita.
11. Higher fertility levels of rural Nigeria can partly be explained by a higher percentage of Muslim and traditionalist women.

3. Research Design

3.1. Type of research

The objective of this research is to compare rural and urban fertility in Nigeria and to find out which determinants are responsible for this difference. Although research trying to explain high fertility in SSA is common practice, a lack of focus between rural and urban differences can be observed. Nigeria has not been studied recently with regards to this subject either. In this study, the researcher tries to find reasons *why* there is a difference between rural and urban fertility. This means the research purpose is explanatory (Babbie, 2010). Different relations between multiple variables and the dependent variable (i.e. fertility) will be studied.

The way to study these relationships is by doing quantitative research. Quantitative research turns information into numbers (Babbie, 2010). These numbers are then subjected to statistical research methods to find statistically significant associations. Comparability is one of the biggest advantages of quantitative analysis, which fits the research objectives of this research well (Babbie, 2010). DHS data is cross-sectional, which describes the state of a country at a certain point in time (Babbie, 2010). Multiple cross-sectional surveys allow to study changes over time in the characteristics and behavior of the population, but cannot measure changes at the individual level. In this research multiple DHS surveys will be used in order to analyse changes at the population level of Nigeria. Lastly, the researcher wil use the statistical software program STATA, to perform the statistical tests.

3.2. Data Collection Method

To answer the research questions, DHS data are used. The DHS survey is a nationally representative survey, which provides data on important indicators of health, population and nutrition (DHS, 2020b). DHS surveys are, if possible, conducted every five years to allow for comparison over time. The DHS program conducts its surveys in developing countries, aiming to advance the understanding of health and population of these nations (DHS, 2020c). The DHS program is funded by the United States Agency for International Development (USAID). DHS surveys consist of multiple extensive questionnaires with different topics (household, women, men and biomarkers). Data on health, employment, residence, family status, personal characteristics, wealth and education are all present in the questionnaires. The sample is usually based on a stratified two-stage cluster design. In the first

stage Enumeration Areas are selected, which are most often drawn from census data. In the second stage households are drawn randomly from the most recent list of households. The data are freely available, but before being able to access the data, some questions will be asked to ensure the researcher has a legitimate research purpose.

3.3. Study Population

The study population will be women in the fertility age group (15-49) in Nigeria. This group is chosen, because this is the only part of the population that is at risk of having a child. They are the group that essentially determine fertility. Multiple years of the DHS will be taken. Table 1 summarizes the specifics of each DHS survey used for this research.

Table 1. Different DHS waves represented in this research

Year	**2008**	**2013**	**2018**
Phase	DHS-V	DHS-VI	DHS-VII
Sample size	33.885	38.948	41.821

This research specifically focusses on Nigeria, because of multiple reasons. Most importantly, Nigeria is projected to experience the second largest growth in population out of all nations in the world, only India will grow faster (UN, 2019). Between 2019 and 2050, the UN expects Nigeria to increase its population with 200 million people. By the end of the century, Nigeria could become the third largest country in the world with a population of 733 million people. This means that Nigeria will be one of the fastest growing countries in the world within the fastest growing continent in the world. Many environmental and socioeconomical issues are likely to arise from this. This means Nigeria may be one of the the most important countries to study with regards to fertility and can benefit a lot from limiting it. Another reason for choosing Nigeria is that multiple recent years are present for the country, allowing for comparison over time.

3.4. Operationalization

3.4.1. Dependent Variable

The dependent variable that captures fertility is 'The number of life births in the last five years.' The variable is chosen, because it shows a woman's fertility behavior in a fairly recent time frame.

The dependent variable is a count variable. The biggest difference between a continuous variable and a count variable is the fact that count data is discrete (Coxe et al., 2009). This means that count data can only take on whole values, while continuous values can take on endless values between whole numbers. This also means that count data has a limited number of possible outcomes. In addition, a count variable is always a number of occurrences over a specific period of time. This means that the values cannot be negative.

3.4.2. Independent Variables

Table 2 shows a list of the background characteristics, age and type of place of residence. Next to this, are the variable(s) of the DHS that try to capture it. The next part will clarify these variables.

Table 2. Operationalization of independent variables

Determinant	**Variable**
Rural or urban residence	Type of place of residence (v025) - Urban (1) - Rural (2)
Age	Women's age in years (v012) - 15 to 49
Education level	Highest educational level (v106): - No education (0) - Primary (1) - Secondary (2) - Higher (3)
Income	Wealth index (v190): - Poorest (1) - Poorer (2) - Middle (3) - Richer (4) - Richest (5)
Infant and child mortality	Ratio of children that have passed away below the age of 5 compared to total number of children (MR) - 0 to 1
Religion	Religion (v130) - Catholic - Other Christian - Islam - Traditionalist - Other
Woman empowerment	Views on wife beating index (VWBI): - 0 to 5 Views on sex refusal (VSRI): - 0 to 1 (3 for 2008) Has a job - No (0) - Yes (1)

Age is included in the table, because this is a variable that will be controlled for. This is the only demographic control variable that will be added, because the sample controls for gender already and union status is considered a proximate determinant.

Education level is divided into four categories, according to definition of UNESCO (2011). In primary education individuals obtain an elementary educational understanding. Children are taught to read and write and also learn the basics of subjects like mathematics. Secondary education prepares children for either employment or further tertiary education. Higher or tertiary education is either academic level, advanced vocational or professional education.

The wealth index is the best way to measure economic status of individuals in the DHS, as income is not measured directly. This index is divided into five categories from poorest to richest. It is calculated by using data on household ownership of certain assets (DHS, 2020d). Things like owning a television or having access to sanitation facilities are included in the calculation. After the index is calculated, individuals are divided into one of the five categories (table 2).

Although the number of children that have passed away below the age of five is the accepted way to measure child mortality, some things need to be mentioned about this variable. The variable is represented as a ratio, to take away the effect of total number of children a person has on the number of them that have died. An individual who has had 15 children over their lifetime has more risk of having a high number of them having passed away. The data may still be subject to some bias, though. All women that did not have any children yet, will score 0 on the child mortality measure, as they cannot have experienced any loss of children yet. This has to be kept in mind, when analyzing the variable's effect on the difference between rural and urban fertility. It could be that part of its effect on the difference between rural and urban fertility is caused by the difference in women between 15 and 49 that do not have children.

Religion is divided into five categories and is based on the religious group the respondent identifies herself with (DHS, 2018). The 'other' category includes everyone that does not represent one of the other religions (e.g. atheism)

In the literature, DHS variables about women's decision making or attitudes on a range of subjects are used to measure their empowerment (e.g. Woldemicael, 2009; Upadhyay & Karasek, 2012). In this research, several of these variables are used, based on the work of Upadhyay & Karasek (2012) and Phan (2015). Two variables will be taken from the research of Upadhyay & Karasek (2012). These are 'Views on wife beating' and 'Views on sex refusal'. Upadhyay & Karasek (2012) use a third variable named 'daily decisions', which measures how much power women have in daily decisions. Unfortunately, this is only measured among married women, which makes it unusable for this research. The two variables that will be used, are turned into index variables. The 'Views on wife

beating index' (VWBI) and the 'Views on sex refusal index' (VSRI) consist of multiple questions. The questions that are included in the indices are described in table 3. Only women who clearly answered 'yes' for the attitudes towards sex refusal indicators, 'no' for the wife-beating indicators are counted as a one in the index for that particular question. The higher a woman scores on these indices, the more empowered they are. For 2013 and 2018, the VSRI only includes one question, making it a proxy variable.

Phan (2015) mentioned two more variables that capture women's empowerment. Whether the respondent has a job is said to be the most important factor in measuring empowerment. Education level is also mentioned as a measure for empowerment. As this research already includes this last variable as a development indicator, only employment status will be added as a proxy.

Table 3. Variables included in the indices

Index	Variables	Options
Views on wife-beating	- Beating justified if wife goes out without telling husband (V744a) - Beating justified if wife neglects the children (V744b) - Beating justified if wife argues with husband (V744c) - Beating justified if wife refuses to have sex with husband (V744d) - Beating justified if wife burns the food (V744e)	- Yes/don't know/missing (0) - No (1)
Views on refusing sex	- Reason for not having sex: husband has sexually transmitted disease (633a) - Reason for not having sex: husband has other women (633b) - Reason for not having sex: tired, mood (633d)	- No/don't know/missing (0) - Yes (1)

Note. 633a and 633d are only collected for the 2008 DHS

3.5. Research Methods

The first step in answering the research questions, is to find out if there are differences between rural and urban areas for the different determinants of fertility. A simple cross tabulation chi-square test will be performed for the categorical variables (i.e. education level, wealth index, religion, employment status and the VSRI for 2013 and 2018) and a *t*-test will be performed for the continuous variables (i.e. age, child and infant mortality, the VWBI and the VSRI for 2008). If there are statistically significant differences ($p<0.05$) between the two types of place of residences, the next step will be Poisson regression.

The method by which the research questions will be answered is with Poisson regression. Although the dependent variable is numerical, OLS linear regression will likely produce biased results. A number of assumptions of OLS regression are violated with a dependent count variable (Coxe et al., 2009). First of all, count variables often show inconsistent variance or heteroscedasticity. This means for certain values of X (i.e. independent variable), Y (i.e. the dependent count variable) will have a much larger range of results than for other values. The fact that count variables often show many low values, but no negative ones, means that the dependent variable is not distributed normally. Poisson regression is able to linearize this non-linear relationship between the X and Y variables, by transforming the dependent variable. The dependent variable is made into a natural logarithm:

$$Ln\ (Y_i) = b_0 + b_1X_{1i} + b_2X_{2i} + \ldots + b_nX_{ni} + e_i$$

Where:

Y = the count variable

b = coefficient

X = the independent variables

Additionally, Poisson regression allows for much more flexibility in the error structure (Coxe et al., 2009), which does not have to be distributed normally, like in OLS regression. The Poisson distribution does not allow for negative values and only takes discrete values, which makes it attractive for the dependent count variable (Coxe et al., 2009). The Poisson distribution is specified by only one parameter, which is μ. The parameter μ defines both the mean and variance of the distribution. This entails that the mean and variance of the dependent variable in Poisson regression, have to be very similar.

The histograms in Appendix A are created to see if the dependent variable 'number of life births in the last five years' is appropriate for Poisson regression. The figures show three histograms representing the DHS data of Nigeria in 2008, 2013 and 2018. All three histograms show a Poisson distribution.

Table 4. Mean and Variance of variable 'Number of births in the last five years' in Nigeria's DHS.

Year	Mean	Variance
2008	0.841892	0.861224
2013	0.817200	0.819110
2018	0.817598	0.827323

As mentioned, in Poisson regression the mean must be very close to the variance. Table four shows the variances and means of the different DHS surveys adjusted by survey weights. The data shows that variance and mean are very similar the for all three waves of the DHS. No overdispersion is detected, which means the data is appropriate to perform a Poisson regression on.

The last step in deciding if Poisson regression is the appropriate way of analyzing the data, is to perform a postestimation including all variables of interest. Pearson goodness-of-fit is performed and represented in table 5 (H_0: The data follows a Poisson distribution). The test shows that the model fit is very good. One thing that must be mentioned is that no survey weight variables are used in this post estimation, because that this is not possible in STATA. However, the values of table 5 are strongly in favor of it being a good fitting model, so no big differences are expected when the weights are added. In conclusion, all three testing methods have shown that a Poisson regression is an appropriate method to analyze the data.

Table 5. Goodness of fit test for the model

Test	***P*-value**		
	2008	**2013**	**2018**
Pearson goodness-of-fit	1.0000	1.0000	1.0000

3.6. Ethical considerations

As this research is done by using secondary data, ethical considerations do not have to be considered by the researcher. However, it is important to review the way the DHS survey ensures privacy.

The DHS (2020e) takes measures to ensure privacy and ethical conduct for all parties involved. Institutional Review Boards of both the US and the host countries have reviewed the DHS regarding human rights protection and compliance with national laws. Each respondent of the DHS has read an informed consent, which they can choose to accept or decline. They are also informed that they can choose to skip any question and the interview can be terminated at any time during the process. Anonymity and confidentiality of the data is ensured. The interviews are conducted as privately as possible, without any other members of the household being in the same room. These anonymity and confidentiality measures are taken as some questions may cover sensitive topics, such as domestic violence.

4. Results

4.1. Type of place of residence & number of births

To explore the data and provide context, descriptive statistics are created about placee of residence and the number of births in the last five years. Appendix B includes descriptive statistics about the background determinants.

Table 6. Distribution of the population by type of place of residence in Nigeria

Type of Place of Residence	2008	2013	2018
Rural	64.3%	57.9%	54.2%
Urban	35.7%	42.1%	45.8%
Total	*100%*	*100%*	*100%*

Table 6 describes the component of rural and urban individuals represented in the survey. Although Nigeria's rural population is larger than their urban population, a rapid increase in urban residents can be seen over the years, which means the urbanization rate is high.

Table 7. Distribution of the population by number of births in the last five years in Nigeria

Births in the last five years	2008	2013	2018
0	47.2%	47.5%	47.6%
1	26.1%	27.4%	27.2%
2	22.4%	21.4%	21.4%
3	4.0%	3.5%	3.5%
4	0.3%	0.2%	0.3%
5	<0.01%	<0.01%	<0.01%
6	-	<0.01%	<0.01%
Total	*100%*	*100%*	*100%*
Average	0.842	0.817	0.818

Table 7 shows the distribution of the dependent variable. Again, a Poisson distribution can be seen. For all years, about half of all women between the ages of 14 and 49 had no births in the five years preceding the survey. On average, about 27% had one child and 22% had two. About 4% covers the remainder of individuals, which all had three births or more. Over time, no large development in fertility is present when looking at the percentage distribution. The fact that it has been stable over the last years emphasizes the lack in fertility decline in Nigeria. Table 7 also includes the average number of children a woman is expected to have. The mean number of births in the last five years was highest in 2008 and has gone down since then. 2013 and 2018 have nearly the same average, 2018 being slightly higher.

Table 8 combines the previous two tables to explore differences in fertility between rural and urban areas of Nigeria. The table shows that over time, fertility in both rural and urban areas does not change much. There is a clear difference between the rural and urban number of births. With the urban region having a larger (about 55%) component of women without any births in the last five years than the rural region (about 42%). For all values above 0 births, rural women have higher percentages. This already indicates that fertility is higher in rural areas of Nigeria than in urban regions. Again, the average number of births in the last five years is reported. As expected, the average fertility is higher in rural than urban areas. The difference in average fertility between rural and urban diverges over the years, mainly because urban fertility goes down faster than rural fertility. The average number of births in both urban and rural areas decreases from 2008 to 2013, but increases from 2013 to 2018. Lastly, a chi-square test for independence is reported in table 8 as well. The statistically significant values confirm that the number of births in the last five years is dependent on type of place of residence.

Table 8. Population by number of births in the last five years and type of place of residence in Nigeria

Births in the last five years	**2008**		**2013**		**2018**	
	Urban	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
Percentages						
0	55.3%	42.6%	55.7%	41.5%	54.5%	41.7%
1	23.1%	27.8%	24.3%	29.6%	25.5%	28.6%
2	18.0%	24.8%	16.9%	24.7%	16.8%	25.3%
3	3.3%	4.4%	2.9%	4.0%	3.0%	4.0%
4	0.3%	0.3%	0.2%	0.2%	0.1%	0.4%
5	-	0.04%	0.02%	0.01%	<0.01%	0.02%
6	-	-	-	0.01%	<0.01%	0.03%
Total	100%	100%	100%	100%	100%	100%
Average	0.700	0.921	0.678	0.918	0.687	0.927
χ^2	p<0.001		p<0.001		p<0.001	

4.2. Background determinants & place of residence

Before testing for a possible relationship between the determinants and urban and rural fertility differences, it is important to test if differences exist between the determinants and rural and urban residence in general. When there is no significant difference, it is not likely that this variabel contributes to the explanation of the urban rural fertility difference. Table 9 shows information on the relationship between the numerical variables and place of residence with *p*-values of different *t*-tests. Appendix C includes more information on these different *t*-tests. Figure 4 to 8 show information on the relationship between the categorical determinants and place of residence, including a chi-square tests of independence. With a *p*-value of 0.05 or less, we consider that there is

a statistically significant difference between rural and urban areas for that certain variable.

Although age was not one of the background determinants, it is important to study its effect. Age composition has changed a lot between place of residence, over the different DHS surveys (table 9). In 2008, rural residents were significantly older than urban ones. There was no significant relationship in 2013. In 2018, urban women between 15 and 49 were significantly older. This suggest that the age composition of rural and urban areas has changed substantially over the years.

The infant and child mortality ratio is very significant for all years and behaves like it was expected to according to hypothesis 2 (table 9). Rural areas experience a higher rate of child and infant mortality than urban areas do. Literature has made the same conclusion, stating that urban individuals experience substantially lower child and infant mortality rates (Shapiro & Tambashe 1999; Shapiro & Gebreselassie, 2008).

Table 9. Numerical background determinants and type of place of residence with t-test

Determinant	**2008**		**2013**		**2018**	
	Urban	**Rural**				
Age						
Mean	28.51	28.80	28.91	28.72	29.34	28.81
Standard error	9.20	9.61	9.56	9.63	9.59	9.63
P-value	0.032		0.135		<0.001	
Infant and child mortality ratio						
Mean	0.06	0.11	0.05	0.11	0.05	0.09
Standard error	0.15	0.21	0.15	0.20	0.14	0.18
P-value	<0.001		<0.001		<0.001	
VWBI						
Mean	3.96	3.25	4.24	3.57	4.48	3.60
Standard error	1.67	1.94	1.44	1.90	1.31	1.99
P-value	<0.001		<0.001		<0.001	
VSRI						
Mean	2.14	2.02				
Standard error	1.00	1.08	-		-	
P-value	<0.001					

Note. 2013 and 2018 of the VSRI are proxy variables, which is why they are considered categorical and included in figure 4

The VWBI shows significant values for all years (table 9). Rural women score lower on the index on average, meaning that rural women are less empowered in this place of residence. On average, rural women think that a bigger portion of the reasons for wife beating is justified. The VSRI has significant values for 2008 (table 9) and 2013 (figure 4). This, again, shows that urban women are more empowered for these years. However, the differences are not large. Especially for 2013, the difference is small. For 2008 the difference is more convincing, which might be explained by the fact that for this year, the index is calculated differently, consisting of three instead of just one question. For 2018, there is no proof of the difference between rural and urban residence at all. When looking at figure 4, it looks like this is because rural women approach the levels of urban women with regards to their views on sex refusal. Which means that women may have become more empowered with

regards to the VSRI in this place of residence, while empowerment of urban women remained stable. For 2008, no significant difference in employment exists between rural and urban women (figure 5). In the next two waves, the difference becomes significant. However, the difference in percentage of women that have a job remains small. All in all, hypothesis 3 can be confirmed for the VWBI, the VRSI in 2008 and 2013 and the employment indicator for 2013 and 2018. Meaning that hypothesis 3 finds some evidence, although not very convincing. In their article, Dodoo & Tempenis (2002) did mention that in rural areas, males are often still dominant, in contrast with urban males.

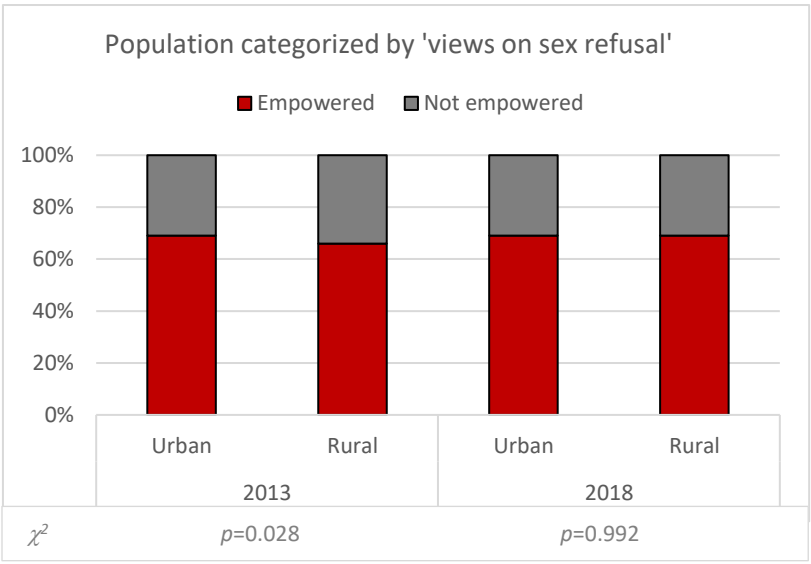


Figure 4. Differences in VSRI between rural and urban

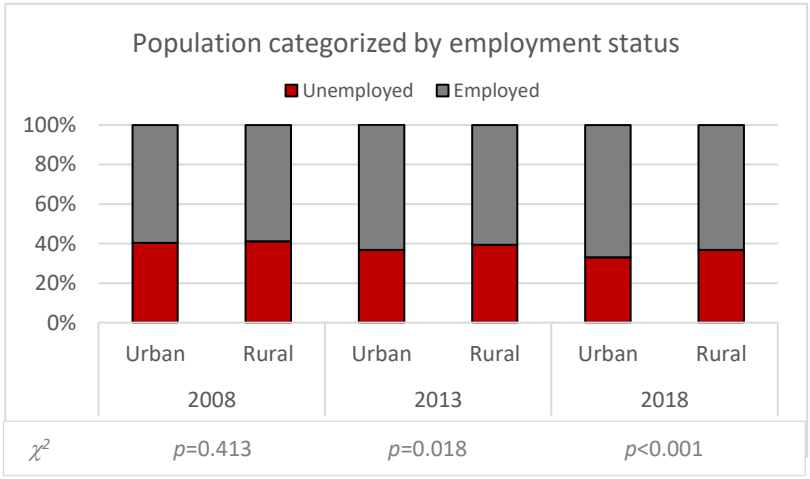


Figure 5. Differences in employment status between rural and urban

There are significant differences between urban and rural areas of Nigeria regarding education level (figure 6). As expected, a large number of rural women have no education (about 50%). Secondary educated women also cover a substantial part of the rural population (i.e. 28.1% 24.7% and 28.8%). Only about 5% of rural women are higher educated. About half of all urban women are secondary educated. Another 17% (on average) is higher educated. The remainder of urban women has had only primary or no

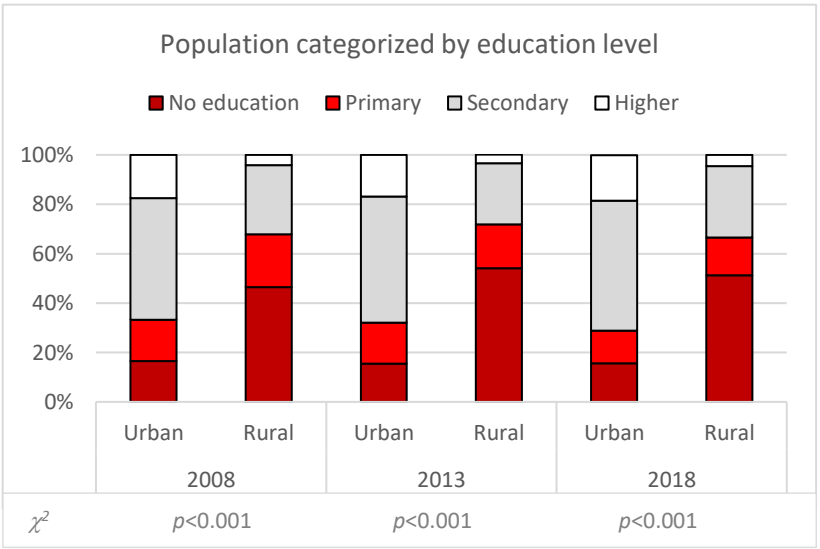


Figure 6. Differences in education level between rural and urban

education. These figures suggest that, on average, urban women are significantly higher educated than rural women, the differences being substantial. Hypothesis 4 can be confirmed for all years. This is also in agreement with the study of Shapiro, & Tambashe (1999), who found that urban woman have more schooling on average.

All year's show significant differences in wealth index between rural and urban areas (figure 7). The difference is substantial, with rural areas having a large percentage of women falling in the poorest, poorer or middle category. Urban areas have a large percentage of the richest women, but many urban women also fall in the richer category. This suggest that the average woman living in a rural area is less wealthy than the average woman living in an urban area. For all years, hypothesis 5 can be confirmed.

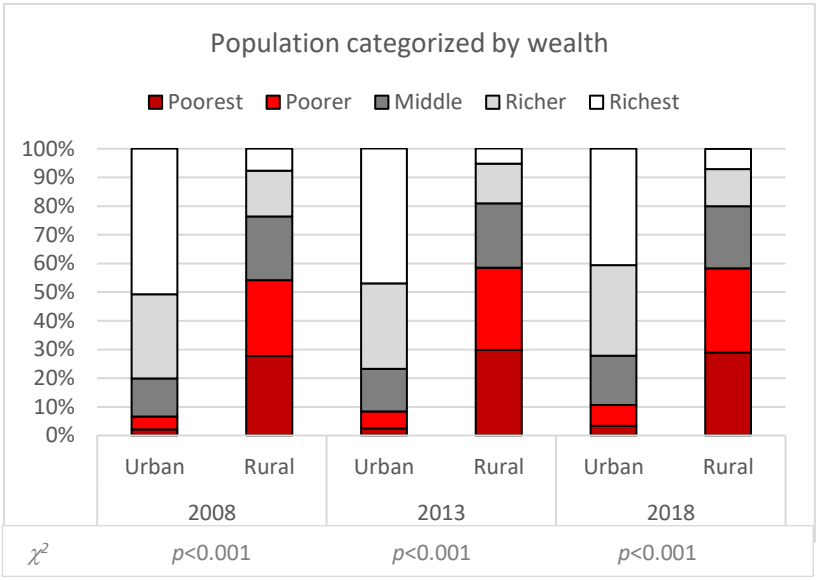


Figure 7. Differences in wealth between rural and urban

Different religions are represented differently between rural and urban (figure 8). All year's show high significance. In rural areas, traditionists and Islamic individuals are represented better, whereas urban areas have a higher component of catholic and other Christian women. This is exactly what was hypothesized for this determinant (hypothesis 8).

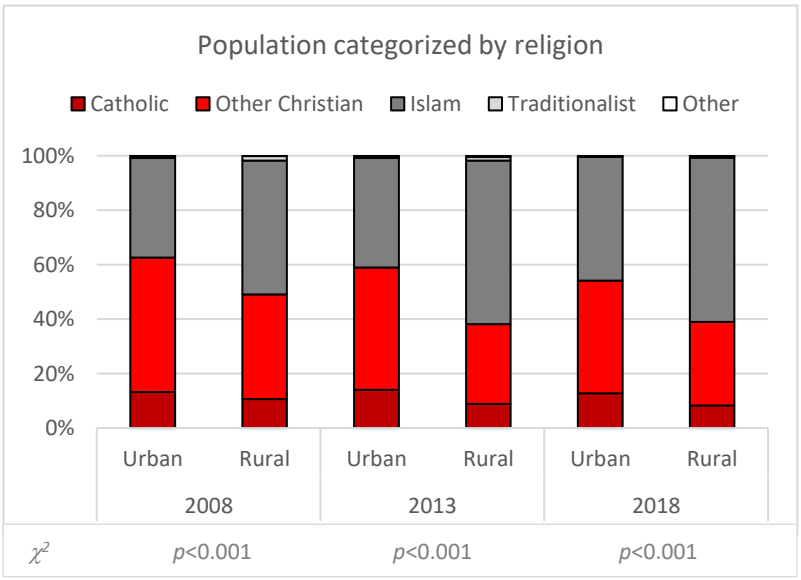


Figure 8. Differences in religion between urban and rural

From these tests, it becomes clear that most determinants show significant proof of different values between urban and rural areas. Some determinants are insignificant for a certain year, but these are significant for the other years. For this reason, all determinants will be included in the regression model.

4.3. Background determinants and Rural & Urban Fertility

Now that a relationship has been established between the different determinants and type of place of residence, the next step is to find out to what extent these variables determine the difference between rural and urban fertility levels. The first model will only include type of place of residence and the dependent variable, to get an idea of the differences without any other variables involved. The next model will include all background determinants and the demographic control variable *age*. The incidence Rate Ratio (IRR) will be reported in the regression, which is the exponent of the coefficient of a certain independent variable. This can be interpreted as the factor with which the dependent variable is expected to increase, when that certain independent variable increases with 1. For type of place of residence this factor will be the ratio between rural and urban births in the last five years (as urban = 1 and rural = 2). After the regressions, a table will be reported that will indicate the effect each determinant has on rural fertility compared to urban fertility, when including it to the model of table 10. Appendix D is created to show more detailed information on the regressions, including the 95% confidence interval and exact *p*-values. Table 10 is the basic model, which indicates the difference between rural and urban fertility, without any of the background determinants.

Table 10. Poisson regression model with dependent variable and 'type of place of residence'

		IRR	
Variable	**2008**	**2013**	**2018**
Type of place of residence			
Urban	1.000	1.000	1.000
Rural	1.314***	1.355***	1.350***
***F*-test**	120.44***	161.67***	147.09***

p<0.001***, *p*<0.01**, *p*<0.05*

As expected, the difference between rural and urban fertility is significant at a *p*<0.001 significance level. On average, a rural woman between the ages of 15 and 49 in Nigeria is expected to have had 31.4% higher rate of birth the last five years in 2008. For 2013 and 2018 the difference is even larger with 35.5% and 35% respectively. The IRR can also be interpreted as the ratio between the rural (numerator) and the urban (denominator) mean number of births in the last five years. For 2008 this would be:

$$\frac{0.92056}{0.70049} = 1.31418$$

This is indeed the same value as the regression produces. Now the difference between rural and urban fertility has been established, the next step is to add the background determinants and

age into the model. The model of table 11 has been created to look at what effect the background determinants have on urban and rural fertility.

Table 11. Poisson regression model with the background determinants

	IRR's and *F*-scores		
Variable	**2008**	**2013**	**2018**
Type of place of residence (*Wald test)*	*(2.6)*	*(6.27*)*	(8.28**)
Urban (reference)	1.000	1.000	1.000
Rural	1.040	1.054*	1.064**
Age	0.995***	0.994***	0.998**
Highest educational level (*Wald test)*	*(104.76***)*	***(**94.77***)*	***(**64.13***)*
No education (reference)	1.000	1.000	1.000
Primary	1.019	0.950*	0.879***
Secondary	0.682***	0.685***	0.747***
Higher	0.615***	0.623***	0.784***
Wealth index (*Wald test)*	***(**1.33***)***	***(**1.36)***	***(**7.47***)*
Poorest	0.983	0.978	1.003
Poorer (reference)	1.000	1.000	1.000
Middle	0.966	0.957*	1.024
Richer	0.940*	0.960	0.940*
Richest	0.955	0.963	0.879***
Rate for component of children that have died before the age of 5	2.051***	1.871***	2.279***
Religion (*Wald test)*	*(*27.76***)*	*(19.60***)*	*(25.78***)*
Catholic (reference)	1.000	1.000	1.000
Other Christian	1.004	1.036	0.977
Islam	1.251***	1.240***	1.202***
Traditionalist	1.168**	0.974	0.907
Other/missing	0.956	1.364**	1.203*
VSRI	1.043***	1.055***	1.054***
VWBI	0.998	0.991*	0.992*
Has a job (*Wald test)*	*(239.6***)*	*(307.55***)*	*(164.79***)*
No (reference)	1.000	1.000	1.000
Yes	1.296***	1.395***	1.209***
***F*-test**	138.04***	123.49***	120.05***

p<0.001***, *p*<0.01**, *p*<0.05*

Almost all variables show a significant effect on the number of births in the last five years. Only differences in the VWBI in 2008 seems to be unrelated to fertility entirely. Wald tests (adjusted for survey weights) are also reported. The most important information to be gained from the Wald test is if the combined effect of all possible outcomes in categorical variables. Significant Wald tests mean that the variable indeed add something to the model (*F*-scores are reported). Type of place of residence in 2008 does not have as significant contribution anymore, which confirms the fact that differences in the background determinants included are the reasons for the initial difference (table 10). The wealth index in 2008 and 2013 do not have a significant contribution to differences in the

number of births in the last five years either. When subtracting education to the model, the reason for this relationship becomes clear. The removal of education level out of the model makes wealth index significant for all years. It looks like, the effects of education level and wealth index partly overlap. All other categorical variables do have significant effects.

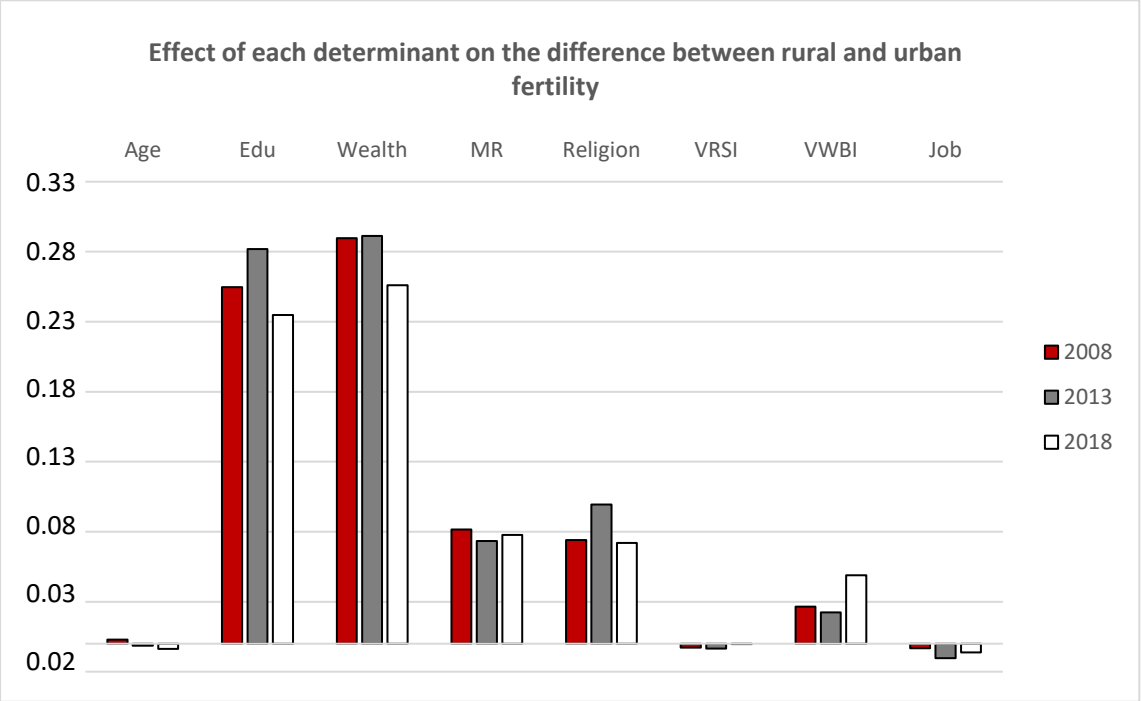
An *F*-test for the entire model has also been reported as well. All models are significantly better than the basic model with only the intercept. The *F*-scores are fairly similar over the years. However, the DHS wave of 2008 has the best score, followed by 2013 and 2018.

When comparing the regression models (table 10 & 11), it becomes clear that adding the background determinants leads to a large decrease in the difference between rural and urban fertility. Hypothesis 1 can partly be confirmed. Indeed, differences in the background determinants between urban and rural areas are related to a large part of the differences in fertility between these two types of residences. For 2008, 2013 and 2018 the original differences between urban and rural fertility was 31.4%, 35.5% and 35% respectively. Differences in the background determinants cause the remaining differences to be 4% (2008), 5.4% (2013) and 6.4%. (2018). For 2008 the difference is not significant anymore, but for the other two years, it is. The fact that 2013 and 2018 are still significant could be related to the fact that the initial difference in fertility between rural and urban was larger in the latter two years. The remaining difference could also be due to the fact that other background determinants, that were not included in the model, are involved, like the physical characteristics of rural and urban areas.

According to the models, large differences exist in the effect of the determinants on rural and urban fertility and fertility in general, between the different DHS waves. This may be the case, because of the compositional changes both rural and urban areas of Nigeria have gone through as a result of urbanization. In 2008, Nigeria's urban population was only 35.7% of the total population, but in 2018 it was already 45.8% (table 5). This is a substantial increase in ten years' time. The next step will be to get a picture of the nature and effect of each determinant on urban and rural fertility.

To make an indication of the effect each determinant has individually on the difference between rural and urban fertility, figure 9 is created. The value shows the effect each determinant has on the IRR of place of residence. Positive values mean that, when adding the variable to the model, the difference between rural and urban fertility shrinks. Which subsequently means that differences in values of the determinant between rural and urban areas are related to part of the difference between rural and urban fertility. For example: education level shows consistent positive values in figure 9, which means that differences in this variable between urban and rural regions lead to part of the difference between rural and urban fertility. To be more specific, a lower percentage of educated individuals in rural areas are part of the reason why rural fertility is higher than urban fertility. Another variable that has high positive values is the wealth index. Child mortality and

religion also have a substantial positive value. The effects of age and the empowerment indicators are not very strong, although the VWBI does have a small effect.



Note. MR is the child and infant mortality ratio

Figure 9. Effect on the IRR of place of residence, when adding the determinant to the basic mode

The next part of the analysis will consider all results and discuss them together, to see what effect each determinant has on the difference between rural and urban fertility. results will then be compared to contemporary literature, if possible. Age will first be discussed, followed by each background determinants.

4.3.1. Age

When controlling for all other variables, age is significantly related to the number of births in the last five years (table 11). The older a woman gets, the less births they are expected to have had in the last five years. For all years, the variables effect on the difference between rural and urban fertility is minimal (figure 9).

4.3.2. Infant and child mortality

There is a significant and strong effect of infant and child mortality on the of number births in the last five years (table 11). This in combination with the determinants difference between rural and urban

areas, leads to the effect on the difference between rural and urban fertility (MR in figure 9). A higher ratio of child and infant mortality in rural areas is part of the reason why rural fertility is higher in Nigeria. This is what hypothesis 7 also stated, which means it can be confirmed. All effects are comparable over the years.

Contemporary literature has found the same relationship between fertility and child mortality (Shapiro, & Tambashe, 1999; Shapiro & Gebreselassie, 2008; Shapiro & Tenikue, 2017). They also mentioned that mortality rates are lower in urban areas. The article of Shapiro & Tambashe (1999) is the only article that also studies the effect this has on the difference between rural and urban fertility directly. They concluded that the variable is part of the reason why rural fertility is higher in SSA. They also mentioned that the effect of child mortality on fertility is only significant for women between the ages of 15 to 29.

4.3.3. Women Empowerment

A high empowerment score in the VSRI is related to slightly higher fertility, when looking at table 11. The previous section has already established that VSRI is significantly higher in urban areas for 2008 and 2013, but not for 2018. The fact that both of these effects are not very strong may be the reason why the variables effect on the difference between rural and urban fertility is small as well (figure 9). The small effect that does exist is the opposite from what was hypothesized, which is likely because the variables effect on fertility is opposite from what was expected as well, which is that higher empowerment for this indicator leads to higher fertility. There is not enough evidence to be able to confirm hypothesis 8 for this indicator.

For 2008 the variable is entirely unrelated to the births in the last five years (table 11). In 2013 and 2018, the index is significantly related to fertility, higher empowerment scores leading to a lower expected number of births in the last five years. This, in combination with the differences in scores between rural and urban areas, leads to the variable having a contribution to the higher fertility levels in rural regions. Although, as the effect of the VWBI on place of residence and fertility is not large separately, the effect on the difference between rural and urban fertility is not large either (figure 9). However, for 2018, the variables effect is relatively big, which may be because the difference in empowerment scores between rural and urban was the largest out of all years in this year. Hypothesis 8 can be confirmed for this indicator for 2013 and 2018. For 2008 the effect is less clear, as the relationship between the indicator and fertility is insignificant for this year.

Women with a job have shown significantly higher fertility than those without a job (table 11). As one might expect when looking at the variables effect on fertility (i.e. employed women show

higher fertility), the effect on the difference between rural and urban fertility is negative (figure 9). This means that differences in employment between rural and urban areas are actually related to smaller differences in fertility than when employment levels would be the same in rural and urban Nigeria. However, the negative effect is small. For this indicator, hypothesis 8 can be rejected. As the different indicators for women empowerment show weak and differing results, hypothesis 8 cannot be confirmed.

Most literature considers education level as a part of women' status (Hogan et al., 1999; Phan, 2015; Woldemicael, 2009). Hogan et al. (1999) also consider employment a measure of women's status. They found that women tend to want to limit births more when they are employed. They also use more contraception. These results are especially strong for rural women. This is the opposite conclusion this research makes. This could also be due to the fact that different dependent variables were tested or because different countries were the subject. Wanting to limit births may not lead to an actual decrease in fertility for example.

Another study in Kenya (Dodoo & Tempenis, 2002) mentioned that men have more decision-making power with regards to fertility in rural areas. For urban areas this is not the case. This indicates that men have more power in rural areas, leading to higher fertility. The fact that women have more empowerment in urban areas is consistent with the findings of this study. However, the results of the different measures of empowerment on fertility of the study of Dodoo & Tempenis (2002) are too inconsistent to make any strong conclusions. This is, in part, the same conclusion that most literature made in their research on women's autonomy and fertility preferences (Woldemicael, 2009; Upadhyay & Karasek, 2012). However, Woldemicael (2009) did conclude that women's autonomy will likely lead to lower fertility levels. Especially having 'say' in daily decisions is related most to lower fertility preferences and higher use of contraception. Unfortunately, the daily decisions indicator is a variable that could not be put in the model of this research. Upadhyay & Karasek (2012) did not find a consistent relationship between measure of empowerment and desired fertility, either. Both this research and the literature found mixed and weak results between fertility and women empowerment.

4.3.4. Education level

According to the Poisson regression, the higher a woman's education level is, the lower amount of births she is expected to have (table 11). The joint effect of the variable seems to have become less strong over time. Overall, education level seems one of the most important background determinants that leads rural fertility to be higher than urban fertility (figure 9). This is in line with

the fact that the average rural woman has a lower education level on the one hand and the relationship between education level and fertility on the other. Hypothesis 9 can be confirmed.

Most studies have also concluded that no formal education often leads women to marry earlier, which leads to higher fertility (Ushie et al., 2011; Shapiro & Gebreselassie, 2008; Shapiro & Gebreselassie, 2014). Ushie et al. (2011) also suggest a direct effect of education level on fertility, but do not include any variables to control for. Hogan et al. (1999) found a significant effect of women's education (literacy) on fertility decline, even when controlling for marriage status. Meaning that this is not the only proximate determinant influenced by education level. According to the article, literacy leads women to have more knowledge on contraceptives and a bigger desire to use it. Shapiro & Gebreselassie (2008) concluded that, when including union status and contraceptive use, nearly all of the effect of education level on fertility is taken away. They also mentioned that child mortality controls for a part of the effect of educational attainment, as higher educated people experience lower child mortality levels. Shapiro & Tambashe (1999) test the difference between women with no education and women with any education and found significantly less fertility for those with education in the age groups of 15-19 and 45-49 (including control variables). They also mentioned that these differences account for a part of the difference between rural and urban fertility. All in all, education level is one of the most important determinants of fertility and the difference in fertility between urban and rural areas. This is most likely caused by differences in union status and contraceptive use between the two types of residences.

4.3.5. Wealth

Interestingly, for 2008 and 2013, the 'poorer' category shows higher fertility than the 'poorest' (table 11). Although for all three years there is at least one wealth group significantly different from another, the joint effect of wealth index in 2008 and 2013 is not significant. When looking into this further, it seems that education level controls for a big part of the effect differences in wealth have on fertility. The model without education level causes joint effect of wealth to become significant. The effect of Wealth index on the difference between urban and rural fertility is substantial for all years (figure 9), which confirms hypothesis (hypothesis 10). In 2018 the effect of wealth on the difference between rural and urban fertility is lower, even though its effect on fertility is larger. This could be because differences in wealth between rural and urban areas seems to have become slightly smaller (figure 7). Although the relationship between wealth and fertility does not seem strong initially, it looks like a strong relationship does exist between wealth and fertility differences between rural and urban Nigeria.

As stated before, the literature is not in agreement on the effect wealth or income has on fertility. Shapiro & Gebreselassie (2008) found that an increase in GDP leads to lower levels of fertility decline, which is in contrast with the findings of the current study, although theirs is a macro level study. Garanne & Joseph (2002) found no relationship between income per capita and the start of fertility decline. Bongaarts (2017) has found a negative relationship between GDP per capita and the total fertility rate of SSA's nations. It must be noted that the way wealth is measured and the way fertility is measured are both different between the literature and this research. In 2014, Shapiro & Gebreselassie conducted another research and found that GDP per capita is negatively associated with Union status. They also mentioned that the percentage of married individuals in urban areas is significantly smaller than in rural areas. Union status and contraceptive use, again, seem the most important proximate determinants.

4.3.6. Religion

Islamic women show significantly higher fertility than Catholics and other Christians (table 11). Traditionalists and others are also significant in some years, but they represent a very small percentage of the population, which makes their influence minimal. The fact that Islamic women have high fertility levels and have a large component of their population living in rural areas, suggest that differences in religion are part of the reason why rural fertility is higher than urban fertility. This is indeed true when looking at figure 9. Hypothesis 11 can be confirmed.

Part of these findings confirm what Ushie et al. (2011) stated. This article concluded that religion and other cultural characteristics lead to younger age at marriage. This, in turn, leads to higher fertility. Michael & Odeyemi (2017) have also stated that different cultures and religions living in different areas of Nigeria, have distinctly different TFR's. They specifically mentioned that traditionalists reward high fertility levels, which is only true for this research in 2008. Islamic individuals are not mentioned. Literature found a significant association between being a Muslim and union status (Shapiro & Gebreselassie, 2014; Westoff & Bietsch, 2015; Stonawski et al., 2016) Muslim people, like traditionalists, marry earlier than other religious groups. Again, this is likely to lead to higher fertility levels over their lifetime. Hogan et al. (1999) found that Muslims are far less likely to want to limit their number of births, space between births or use contraceptive methods. Westoff & Bietsch (2015) stated that Muslim individuals show higher fertility, which is partly related to higher child mortality, lower contraceptive prevalence, bigger desired family sizes and early age at marriage for this religious group. However, they mentioned that the effect of being Muslim on fertility remains, even after controlling for those variables.

5. Conclusion

This research set out to answer what determinants cause rural fertility to be higher than urban fertility in Nigeria. Adding all background determinants is enough to explain all of the difference for 2008 and a large part of the difference for 2013 and 2018. The remaining difference may be caused by other background determinants that were not considered.

Most background determinants seem to have at least some role in differences in fertility between rural and urban areas. Especially differences in education level and wealth play a role in causing rural fertility to be higher, although part of their effect may overlap. These two indicators have in common that their values differ quite a lot between rural and urban areas in general. Religion and child and infant mortality show substantial effects as well. Child and infant mortality in rural areas being higher, leading to higher fertility in this place of residence. Islamic women show higher fertility than Christians, which is likely the main cause religion has an effect on rural and urban fertility. As Islamic women are represented more in rural areas, while urban areas have a higher percentage of Christians (Catholic or other Christians). The different determinants for women empowerment show inconsistent results and its relationship with the number of births in the last five years is not strong. Especially employment and the VSRI show weak and even opposite effects on the difference between rural and urban fertility. The VWBI does show the hypothesized result, although the effect is not very strong. All in all, not enough evidence is found to say that differences in women empowerment has an effect on the difference between rural and urban fertility. This research has also showed that some determinants influence fertility different over the years. The changing composition and size of both the rural and urban areas of Nigeria may be causing this.

Contemporary literature in SSA mentioned two proximate determinants that mediate the relationship between the background determinants and fertility the most. Contraceptive use and union status are often mentioned as being influenced by the different background determinant. Literature also mentioned that these two proximate determinants differ between rural and urban areas. It is likely that these two proximate determinants are important in mediating the effect of the background determinants on the difference between rural and urban fertility.

5.1. Recommendations

Future research could focus on reproducing similar micro-level research on different countries in SSA, to find if the same determinants influence the difference between rural and urban fertility for different countries. It will also be useful to add more background determinants that could possibly contribute to high rural fertility, which may explain the remaining differences found in this research (e.g. the physical characteristics of urban and rural areas). Finding a way to add proximate determinants into the model will be useful as well. Doing similar research with longitudinal data to better understand individual fertility behavior over time could bring many new insights into current literature on fertility in SSA, but appropriate data is not yet available.

Studying the effects that education level, wealth, child mortality, religion and women empowerment have provided new insights into what contributes to high rural fertility and to what extent each determinant contributes. Knowing a large part of the reasons why rural fertility is higher, can help limit the number of births in this place of residence. This being said, some of the causes of high fertility can be changed more easily than others. Policy should be focused on improving access to education in rural areas. As about half of the rural women in the fertility ages have not received any education. This may also improve their wealth status, as they will get better job opportunities. Reducing child and infant mortality in rural areas would help to limit fertility as well. Providing better health care may decrease the high infant and child mortality levels that still exist in this place of residence. This, as discussed earlier, will also limit fertility.

5.2. Reflection

In general, this research has made a useful contribution towards the literature about fertility in SSA. Looking back, a few things can be said about the data and literature. Most literature on fertility in SSA has used DHS data (Shapiro & Gebreselassie, 2008; Shapiro & Gebreselassie, 2014; Shapiro & Tambashe 1999; Garanne & Joseph, 2002; Bongaarts 2017; Shapiro & Tenikue, 2017; Woldemicael, 2009; Dodoo & Tempenis, 2002; Upadhyay & Karasek, 2012). As already mentioned, this is often the best data source with regards to health & demographics for the region of SSA. Another upside being that data is often available for multiple years. Extensive national statistics are often not present in many of SSA's nations. Only Hogan et al. (1999), used data from the national statistical office of Ethiopia, which provides representative data for different regions of Ethiopia. Ushie et al. (2011) is the only literature source that collected the data themselves. This study uses an appropriate sampling design to ensure a sample representative of the population under study. All in all, the data

used in the literature seems reliable and representative. One thing that may make some of the data less strong for comparison with this research, is that some of the studies have been done in very different nations from Nigeria. Hogan et al. (1999), Woldemicael (2009) and Dodoo & Tempenis (2002) performed their research in Ethiopia, Eritrea and Kenya respectively. As stated before, Eastern African nations show different fertility behavior than Western and Middle African nations, like Nigeria (Guengant & May, 2001).

Reflecting on the data used in this research, some things must be mentioned. First of all, the dependent variable may not fit perfect with some of the independent variables. As most of the independent variables measure a certain characteristic at the time of the interview, while 'number of births in the last five years' is about the past. The reason why this might be an issue, can be illustrated with an example. A woman has reached secondary education a month before the interview, and had three children in the last five years. It is likely that she conceived those children during the time when she was still primary instead of secondary educated. However, a better dependent variable for individual fertility is not available in the DHS.

The ratio to measure child mortality is not perfect either. It is likely to be influenced by those that did not have had any births at all. These women will score 0 on the ratio, just like women who have had all their children survive to the age of five. The two groups can be quite different, but are the same according to the variable. This, again, is the downside of trying to capture individual data on fertility and its determinants.

Lastly, there are some problems with method to study the effect that each determinant has on rural and urban fertility (figure 9). No statistical significance can be tested with this method. Some effects may also overlap with the other determinants. However, no perfect method exists to be able to study the effect of a set of independent variables on another independent variable in Poisson regression. However, discussing it together with the Poisson regression and the other statistical tests make the results of the figure 9 a lot stronger.

This research has contributed to the literature of fertility in SSA. The research found insights into the reasons for high fertility in Nigeria and explained a large part of the reason why rural fertility is higher than urban fertility in the country.

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Appendix A

Distribution of 'births in the last five years' for women in the fertility ages in Nigeria.

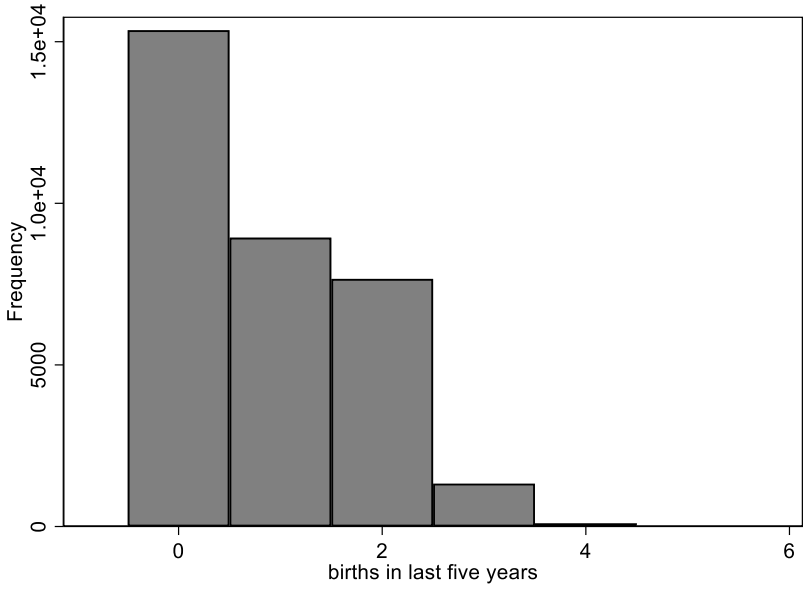

Figure A1. Distribution of 'number of births in the last 5 years' of Nigeria's DHS in 2008

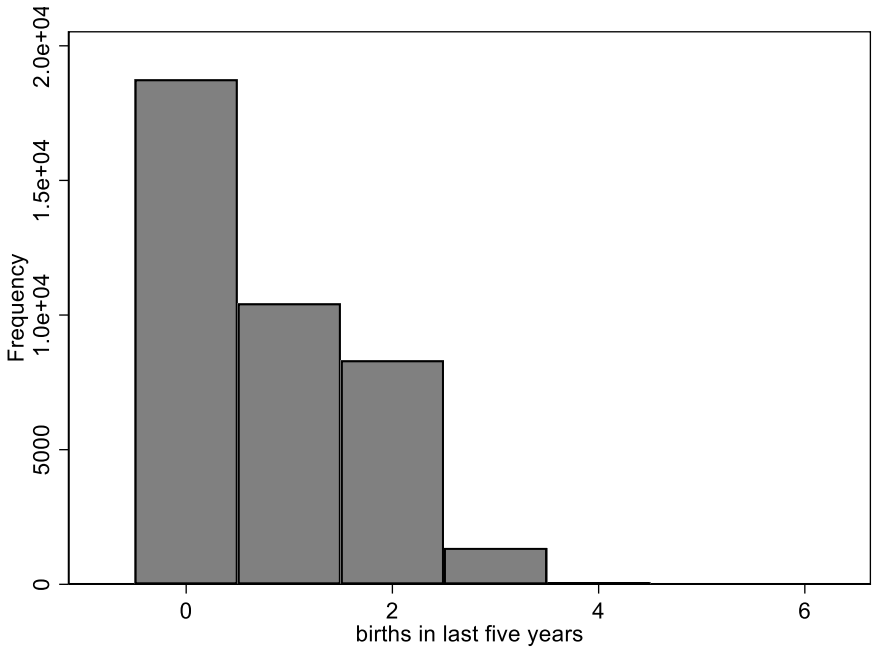

Figure A2. Distribution of 'number of births in the last 5 years' of Nigeria's DHS in 2013

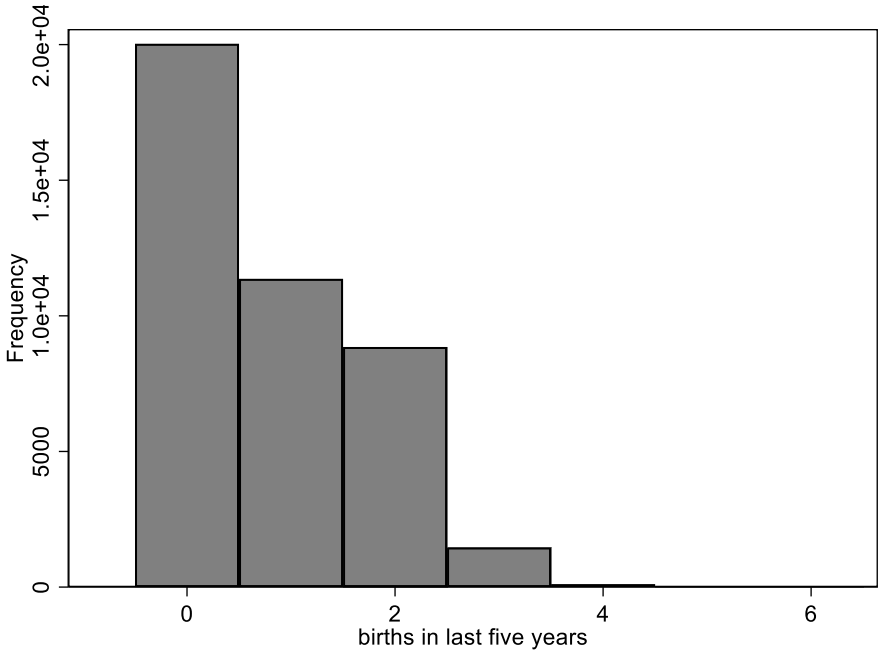

Figure A3. Distribution of 'number of births in the last 5 years' of Nigeria's DHS in 2018

Appendix B

descriptive statistics

Table B1. Basic descriptive statistics of the background determinants

Age	2008	2013	2018
Mean	28.69	28.80	29.1
Standard error	9.47	9.60	9.62
Minimum	15	15	15
Maximum	49	49	49
Wealth index			
Poorest	18.5%	18.3%	17.3%
Poorer	18.7%	19.1%	19.2%
Middle	19%	19.2%	19.6%
Richer	20.8%	20.5%	21.5%
Richest	23%	22.9%	22.4%
Highest educational level			
No education	35.8%	37.8%	34.9%
Primary	19.7%	17.3%	14.4%
Secondary	35.7%	35.8%	39.7%
Higher	8.9%	9.1%	11%
Infant and child mortality ratio			
Mean	0.09	0.09	0.07
Standard deviation	0.19	0.18	0.17
Minimum	0	0	0
Maximum	1	1	1
Religion			
Catholic	11.6%	11.1%	10.4%
Other Christian	42.3%	35.7%	35.6%
Islam	44.6%	51.7%	53.5%
Traditionalist	1.3%	0.9%	0.4%
Other/missing	0.2%	0.5%	0.2%
VWBI			
Mean	3.50	3.85	4.00
Standard error	1.88	1.75	1.76
Minimum	0	0	0
Maximum	5	5	5
VSRI			
Mean	2.07	0.68	0.69
Standard error	1.05	0.47	0.46
Minimum	0	0	0
Maximum	3	1	1
Has a job			
No	40.9%	38.2%	35%
Yes	59.1%	61.8%	65%

Table B2. Descriptive statistics of the background determinants by type of place of residence

Variable	2008 Urban	Rural	2013 Urban	Rural	2018 Urban	Rural
Age						
Mean	28.51	28.80	28.91	28.72	29.34	28.81
Standard error	9.20	9.61	9.56	9.63	9.59	9.63
Minimum	15	15	15	15	15	15
Maximum	49	49	49	49	49	49
Wealth Index						
Poorest	2.1%	27.7%	2.5%	29.8%	3.4%	28.9%
Poorer	4.5%	26.5%	5.9%	28.7%	7.2%	29.4%
Middle	13.3%	22.2%	14.8%	22.5%	17.2%	21.7%
Richer	29.4%	16%	29.8%	13.8%	31.6%	12.9%
Richest	50.7%	7.6%	47.1%	5.3%	40.6%	7%
Highest educational level						
No education	16.5%	46.5%	15.5%	54.1%	15.6%	51.2%
Primary	16.8%	21.3%	16.6%	17.8%	13.3%	15.4%
Secondary	49.2%	28.1%	51%	24.7%	52.5%	28.8%
Higher	17.5%	4.1%	16.9%	3.5%	18.5%	4.6%
Infant and child mortality ratio						
Mean	0.06	0.11	0.05	0.11	0.05	0.09
Standard deviation	0.15	0.21	0.15	0.20	0.14	0.18
Minimum	0	0	0	0	0	0
Maximum	1	1	1	1	1	1
Religion						
Catholic	13.2%	10.7%	14.1%	8.9%	12.8%	8.3%
Other Christian	49.4%	38.4%	44.8%	29.2%	41.3%	30.7%
Islam	36.6%	49.1%	40.3%	60.1%	45.5%	60.3%
Traditionalist	07%	1.6%	0.5%	1.3%	0.2%	0.5%
Other	0.1%	0.2%	0.4%	0.6%	0.2%	0.2%
VWBI						
Mean	3.96	3.25	4.24	3.57	4.48	3.60
Standard error	1.67	1.94	1.44	1.90	1.31	1.99
Minimum	0	0	0	0	0	0
Maximum	5	5	5	5	5	5
VSRI						
Mean	2.14	2.02	0.69	0.66	0.69	0.69
Standard error	1.00	1.08	0.46	0.47	0.46	0.46
Minimum	0	0	0	0	0	0
Maximum	3	3	1	1	1	1
Has a job						
No	40.3%	41.2%	36.8%	39.3%	33%	36.7%
Yes	59.7%	58.8%	63.3%	60.7%	67%	63.3%

Appendix C

T-test with coefficients, *p*-values and 95% confidence intervals

Table C1. T-tests between the different determinants and type of place of residence

Variable	Coefficient (Urban = 1, Rural = 2)	*P*-value	95% Confidence Interval
2008			
Age	0.287	0.032	0.024 – 0.550
Child and infant mortality	0.056	<0.001	0.049 – 0.063
VWBI	-0.712	<0.001	-0.826 – -0.598
VSRI	-0.123	<0.001	-0.180 – -0.065
2013			
Age	-0.189	0.135	-0.436 – 0.059
Child and infant mortality	0.055	<0.001	0.048 – 0.062
VWBI	-0.670	<0.001	-0.758 – -0.582
2018			
Age	-0.529	<0.001	-0.766 – -0.294
Child and infant mortality	0.048	<0.001	0.042 – 0.054
VWBI	-0.873	<0.001	-0.956 – -0.790

Appendix D

Poisson regression with IRR's, 95% confidence intervals and *p*-values

Table D1. Poisson regression model including dependent variable and type of place residence

Variable	IRR	*P*-value	95% Confidence Interval
2008			
Type of place of residence			
Urban	1.000	-	-
Rural	1.314	<0.001	1.252 – 1.380
2013			
Type of place of residence			
Urban	1.000	-	-
Rural	1.355	<0.001	1.293 - 1.421
2018			
Type of place of residence			
Urban	1.000	-	-
Rural	1.350	<0.001	1.291 - 1.412

Table D2. Poisson regression model including all background determinants

Variable	IRR	*P*-value	95% Confidence Interval
2008			
Type of place of residence			
Urban (reference)	1.000	-	-
Rural	1.040	0.107	0.991 - 1.091
Age	0.995	<0.001	0.993 - 0.996
Highest educational level			
No education (reference)	1.000	-	-
Primary	1.019	0.347	0.979 - 1.061
Secondary	0.682	<0.001	0.646 - 0.720
Higher	0.615	<0.001	0.564 - 0.670
Wealth index			
Poorest	0.983	0.378	0.946 - 1.021
Poorer (reference)	1.000	-	-
Middle	0.966	0.124	0.923 - 1.010
Richer	0.940	0.026	0.889 - 0.993
Richest	0.955	0.196	0.891 - 1.024
Rate for component of children that have died before the age of 5	2.051	<0.001	1.941 - 2.166
Religion			
Catholic (reference)	1.000	-	-
Other Christian	1.004	0.899	0.942 - 1.070
Islam	1.251	<0.001	1.173 - 1.335
Traditionalist	1.168	0.003	1.055 - 1.293
Other/missing	0.956	0.815	0.653 - 0.398
VSRI	1.043	<0.001	1.028 - 1.057
VWBI	0.998	0.622	0.991 - 1.006
Has a job			
No (reference)	1.000	-	-
Yes	1.296	<0.001	1.254 - 1.339

Variable	IRR	*P*-value	95% Confidence Interval
2013			
Type of place of residence			
Urban (reference)	1.000	-	-
Rural	1.054	0.012	1.012 - 1.099
Age	0.994	<0.001	0.993 - 0.996
Highest educational level			
No education (reference)	1.000	-	-
Primary	0.950	0.011	0.913 - 0.989
Secondary	0.685	0.000	0.651 - 0.721
Higher	0.623	0.000	0.572 - 0.677
Wealth index			
Poorest	0.978	0.305	0.938 - 1.020
Poorer (reference)	1.000	-	-
Middle	0.957	0.028	0.921 - 0.995
Richer	0.960	0.117	0.912 - 1.010
Richest	0.963	0.236	0.905 - 1.025
Rate for component of children that have died before the age of 5	1.871	<0.001	1.758 - 1.991
Religion			
Catholic (reference)	1.000	-	-
Other Christian	1.036	0.254	0.975 - 1.101
Islam	1.240	<0.001	1.164 - 1.321
Traditionalist	0.974	0.724	0.840 - 1.129
Other/missing	1.364	0.001	1.129 - 1.649
VSRI	1.055	<0.001	1.024 - 1.087
VWBI	0.991	0.014	0.984 - 0.998
Has a job			
No (reference)	1.000	-	-
Yes	1.395	<0.001	1.344 - 1.449
2018			
Type of place of residence			
Urban (reference)	1.000	-	-
Rural	1.064	0.004	1.020 - 1.109
Age	0.998	0.006	0.996 - 0.999
Highest educational level			
No education (reference)	1.000	-	-
Primary	0.879	<0.001	0.841 - 0.919
Secondary	0.747	<0.001	0.717 - 0.778
Higher	0.784	<0.001	0.733 - 0.837
Wealth index			
Poorest	1.003	0.850	0.965 - 1.044
Poorer (reference)	1.000	-	-
Middle	1.024	0.278	0.981 - 1.068
Richer	0.940	0.034	0.888 - 0.995
Richest	0.879	<0.001	0.826 - 0.935
Rate for component of children that have died before the age of 5	2.279	<0.001	2.132 - 2.437
Religion			
Catholic (reference)	1.000	-	-
Other Christian	0.977	0.451	0.920 - 1.038
Islam	1.202	<0.001	1.128 - 1.280
Traditionalist	0.907	0.236	0.771 - 1.066
Other/missing	1.203	0.046	1.003 - 1.442

Variable	IRR	*P*-value	95% Confidence Interval
VSRI	1.054	<0.001	1.026 - 1.083
VWBI	0.992	0.014	0.985 - 0.998
Has a job			
No (reference)	1.000	-	-
Yes	1.209	<0.001	1.174 - 1.244