COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

DEPARTMENT OF STATISTICS

ASSESSMENT OF ETHIOPIAN WOMEN'S DESIRE TO LIMIT NUMBER OF CHILDREN

A thesis submitted to the Department of Statistics in partial fulfillment of the requirements for the Degree of Master of Science in Statistics (Biostatistics)

By: Birikset Zemedkun

Advisor: Prof. Eshetu Wencheko

Addis Ababa, Ethiopia

23 June 2023

Addis Ababa University

Department of Statistics

This is to certify that the thesis prepared by Birikset Zemedkun, entitled: Assessment of Ethiopian women's desire to limit number of children and submitted in partial fulfillment of the requirements for the Degree Master of Science in Statistics complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Name	Signature	Date
Advisor: Eshetu Wencheko (Prof.)	_____	_____
Examiner: _____	_____	_____
Examiner: _____	_____	_____

DECLARATION

I, the undersigned, declare that the thesis is my original work, has not been presented for degrees in any other University and all sources of materials used for the thesis have been duly acknowledged.

Name: Birikset Zemedkun

Signature: _____

Place of submission: Department of Statistics, College of Natural and Computational Sciences, Addis Ababa University

Date of submission: 23 June 2023

This thesis has been submitted for examination with my approval as a University advisor.

Eshetu Wencheko (Prof.) _____

Advisor's Name **Signature**

Acknowledgment

I humbly offer my sincerest gratitude to the **Almighty God** for the wisdom, guidance, and blessing you have bestowed upon me throughout my life.

I would like also to express my deepest appreciation to my advisor; **Eshetu Wencheko (Prof.)**, your invaluable expertise, unwavering support, and mentorship have been instrumental in shaping my research endeavors.

Furthermore, I am immensely grateful to my family who have been my pillars of strength throughout this research journey.

Finally, to all those who have contributed in various way in my research I extend my heartfelt thanks.

Contents

List of Tables

List of Figures

ABSTRACT

The term "fertility preference" refers to the desire for more children or fertility goals as well as the ideal family size and number of children. The size of a family has a significant impact on the well-being and health of each individual, the family, and the community in addition to the welfare and health of a nation as a whole. The general objective of this study was to assess determinants of desired number children among Ethiopia women based on data from Ethiopian Demographic and Health Survey conducted in 2016. In order to study childbearing rates this study employed a count regression models: Poisson, NB, and Poisson inverse Gaussian (PIG) model. We found PIG as the most suitable model for assessing the data at hand. It was found that age and place of residence of women, women education level, religion, wealth index, living children, women's occupation, duration of marriage, and age of women at first birth were significantly associated with the desired number of children that a women want to have. Policy makers may want to consider targeted interventions that address those specific covariates in order to reduce the number of desired number of children in areas where desired family size is higher.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

The size of the family has a significant impact on the well-being and health of each individual, the family, and the community in addition to the welfare and health of the nation as a whole (Arthur, 2005; Hyeladi & Alfred, 2014). Additionally, the number of families and their makeup within a society are largely determined by the financial, cultural and familial consequences of the couples who intend to start families or who are eligible to do so (Uddin et al., 2012). The most crucial aspect of population dynamics is fertility, which may be used to analyze population variations over time. It influences the population's structure and change.

In comparison to the rest of the world, the fertility rate is high in sub-Saharan countries. Ethiopia is undergoing a fast population expansion, much like the majority of Sub-Saharan African nations. Rapid growth hinders efforts at national development and has an impact on mother and child health. The continued increase in the global population has emerged as a pressing issue. The majority of this expansion takes place in poorer nations, where the total fertility rate is slowly declining. The population may not have reached the ideal family size, as suggested by the steady drop in the general fertility rate. The number of children born to women is strongly predicted by variables reflecting desired family size.

Ethiopia is one of the emerging nations with one of the highest fertility rates and fastest rates of population expansion. The Ethiopian household size is 4.6 persons on average, according to the 2016 Ethiopia Demographic and Health Survey (EDHS). Women are the heads of one-fourth of families. In Ethiopia, nearly half (47%) of the population is under the age of 15. Ethiopian women [in the year 2016] had 4.6 children on average. Fertility has dropped from 5.5 children per woman in 2000 to its present level. Ethiopia's total wanted fertility rate (TWFR) is 3.0 children per woman on average, which is 1.6 less than the country's total fertility rate (TFR), which is 4.6.

The Ethiopian government has made a number of attempts to drop fertility numbers. The first official national population policy was launched in 1993, with the goal of lowering the overall fertility rate from 7.7 children per woman to 4.0 by the year 2015 (TGE, 1993).

The population program's implementation strategies include raising the age at first marriage to at least 18 years old, improving the status of women by giving them better employment and educational opportunities, expanding family planning services and information, and promoting communication and education on methods for limiting family size (Bhargava, 2007).

Urban fertility is decreasing in Ethiopia due to modernization factors such improved access to education and the media, work opportunities in the modern economy, and increased availability to family planning services (Kinfu, 2001). The impact of poverty on the reduction in fertility in Ethiopia's major cities is also not insignificant (Grumu and Mace, 2008).

Families frequently choose to have a large number of children in Ethiopia because they view them as assets rather than liabilities when it comes to the country's economy, which is mostly dependent on subsistence farming. Parents in rural areas prefer to have more children so that they can help with farming tasks (Bairagi, 2001).

Large families would absolutely have a negative influence on agricultural practices, healthcare programs, and health care facilities, which would therefore have a significant effect on public health. Large families are likely to have poor health, be unable to appropriately fund children's education, have low standards of living, and be unable to realize their aspirations. Due to their higher levels of education, access to wealth, and income accommodations, small families, on the other hand, have the capacity for one person to enjoy the necessities of life while still having the option to acquire and enjoy some luxuries. Therefore, it would be important for the study to identify the covariates associated with the desired number of children (family size) of households in Ethiopia.

The total number of kids a woman has at any given moment is referred to as her family size (Thomson, 2015). Family size is influenced by several factors at various levels in various societies. It is influenced by several variables, including marital status, age at first marriage, usage of contraceptives, parental education level, ethnicity, polygamy, and length of the marriage. Considering that the practice of regulating family size requires the inspiration and

implementation of family planning techniques. Another important factor in determining the number of children a family wants to have is the desire for a balanced number of daughters and sons or at least one kid of each sex. The planned family size, the women's fertility, and their reproductive behavior are all impacted by this type of gender preference for children [Mason, 1992; Dharmalingam, 1996; Campbell and Campbell, 1997 cited in Essey Kebede and Habitu Liyew (2022)].

Regardless of the number of live children, a significant portion of Ethiopians believes that four or more children form the desirable family size. Men want a family size of 4.8 children, compared to 4.3 children that women wanted. The number of children women consider to be the ideal snumber has decreased during the past ten years, from 5.3 in 2000 to 4.5 in 2005 and 4.3 in 2011. (CSA and ICF International, 2012).

One of the most important factors affecting a country's future population structure is fertility goals and wants, which are central to theoretical and empirical approaches to researching childbearing behavior. By understanding the variables that influence reproductive choices and aspirations, fertility trends can be predicted and population expansion can be reduced.

This study makes an effort to explain fertility practices and identify covariates linked to Ethiopian women's intended childbearing intentions in the context of the aforementioned situations.

1.2. Statement of the problem

The determinants of desired number of children refers to the factors that influence an individual or a couple's decision to have, or not to have, children. Different backgrounds, including educational attainment, cultural background, and other socio-demographic characteristics, have different attitudes toward restricting childbearing. Examples include financial stability, fear of overpopulation and environmental concerns, career aspirations and opportunities for advancement, the availability of quality education for children, and the desire for a certain gender in a child. Investigating what drives people’s decisions on desired family size can give insight into broader population issues such as resource distribution and sustainability of lifestyle choices.

Lastly, by determining the underlying determinants of limiting family size, we can develop evidence-informed programs designed to support achieving desired fertility levels in Ethiopia.

Therefore, the purpose of this study would be to identify potential covariates that could influence the desired number of children among Ethiopian women. This investigation would provide answers to the following questions.

- What are the main factors influencing Ethiopian women's desired number of children?
- What is the average intended number of children for Ethiopian women who are of childbearing age?

1.3. Objectives of the study

The objectives of the study are to (***i***) identify covariates that are associated with desired number children among Ethiopian women, and (***ii***) assess the effects of the predictors/covariates that are identified.

1.4. Significance of the study

Studying the determinants of desired number of children is important for understanding how to promote family planning in the country. This information can inform government policies, health programs and public awareness campaigns on the issue of fertility. It also may help to explain variations in Ethiopia's population size, as family planning plays an important role in managing population dynamics. We can gain a better understanding of the population growth trend into the future.

The findings could also inform in the formation of social programs, policies, and strategic interventions. Additionally, it could provide information to employers, health care providers, economists, demographers and other stakeholders interested in family planning. By understanding determinants of desired number of children, researchers can create targeted strategies to support individuals' reproductive health goals.

Due to the fact that women and children make up two-thirds of the Ethiopian population and that they are more likely to be directly or indirectly impacted, understanding these issues is crucial.

From this study, we can gain a better understanding of the current landscape of Ethiopian family planning practices and the factors that influence them and identify adoptable approaches to assist in increasing access, affordability, and availability of contraceptive methods in Ethiopia.

1.5. Limitation of the Study

Despite the fact that a variety of factors influences the desired number of children, this study aims to examine a few socio-demographic factors that have an impact on fertility in Ethiopia. The EDHS 2016 provided the data for this investigation. As a result, the outcomes could not accurately reflect Ethiopia's current position.

CHAPTER TWO

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Broad Perspective

Fertility is the actual childbearing performance of a population. One of the three main factors in population dynamics—along with mortality and migration—that affects a nation's population is fertility. Furthermore, it is a complicated variable influenced by a number of variables. One of the most common findings in demography is that there are differences in fertility levels and behavior depending on location, population strata, or other factors (Ramesh 2010). The influence of family size on poverty, literacy, health education, and other factors are also well known. The effects of environmental, economic, cultural, and social issues are also fundamental causes of these results. In other words, whether it is the religious, occupational, social, or economic standing of the family as well as its members, economic, sociocultural, environmental, and educational aspects all have an impact on family size. All variables mentioned have an impact on family size. On the other hand, the choice of family size affects the degree of advantage or disadvantage that a person or family will experience.

According to Becker's (1991) theory of the demand for children, a family's decision to have children is influenced by both the financial resources available to them and the associated expenditures. Income plays a role in determining the number of children couples will have because families with higher incomes are more able to afford additional children. Better levels of education, income, health, and quality of life may be available to families with fewer children. A larger family will eventually result in lower levels of income, education, health, welfare, and economic standing. Choosing a family size that would decrease the burden and effect of family size as well as the individual members would be necessary to ensure a better society as well as economic status.

In demographic research, the childbearing years of women are typically considered to be between the ages of 15 and 49 years. A woman who is fecund may or may not also be fertile, while the opposite is true for the other. Age at menarche and age at menopause are the primary occurrences or phenomena linked to fertility. It has been established that getting married late affects fertility. In addition to the use of and attitudes toward contraception, other factors affecting fertility include educational level, economic position, religious beliefs, women's participation in the workforce, etc. (Gebremedhin and Betre 2009).

2.2. Conceptual Framework

Due to the official poverty measure inclusion of family size, Becker (1991) demonstrates that family size has a significant role in determining whether a family or an individual is in poverty. Determinants of family size include family income, the cost of raising children, salaries, government transfers, and preferences. Based on Becker's (1991) theory of the demand for children, a family's decision to have a child or children will be influenced by both the family's financial situation and the associated expenditures. The number of children in a family is influenced by money since households with greater salaries may more easily afford more children. Having children comes with a number of immediate expenses, such as the cost of clothing, food, and medical care. The relative cost is another expense in addition to these direct expenses. The opportunity cost of raising children, as determined by the female salary and, to a lesser extent, the male wage, as well as government handouts, affects the relative cost of having a kid. By changing the relative cost of having a child and establishing incentives or disincentives for marriage, government transfers may have an impact on the number of children and adults in a household.

Moreover, Becker (1976) states that understanding contraception also has an impact on the desire for children. As a result, the demand for children may be impacted by the uneven availability of contraceptive knowledge among regions.

Azumah et al. (2017) state that when compared to children from small homes, children from large families typically enroll in school late, perform badly, and leave school early. They emphasise that the primary causes were poor health, financial difficulties, and a lack of parental involvement. The suburb's kid quality was impacted by several socioeconomic factors as well.

Their results support the hypothesis that large families negatively affect suburban children's educational outcomes.

2.3. Interpretive studies

Dibaba and Mitike (2016) conducted a study between March 25 and April 4, 2013 in Assela, Ethiopia, to identify influential covariates of fertility using a cross-sectional approach based in the community. One of the key findings was that, compared to women who follow orthodox Christianity and Islam, women who identify as Protestant and Catholic had considerably lower mean desired family sizes. Additionally, individuals who had just had their primary education preferred larger families than those with postsecondary education. According to the study's findings, it's feasible that a couple's desire for fewer children may be influenced by their increasing educational attainment and age at marriage. Preferences for family size were influenced by educational level and knowledge about family planning.

Dibaba (2009) showed the influence that exposure to the media has a positive effect on people's desire to avoid having children. Compared to women who have no access to any media, those who have access to at least one of the three media (radio, TV, and newspapers) are 19% more likely to want to limit childbearing.

Ojo and Adesina (2014) support the notion that fertility control is a highly effective tool for women's empowerment and the opposite is true. Women's preference for small family sizes and economic level are positively correlated. In deciding how women regulate their fertility, women's economic levels are crucial. Women who are empowered by education, capacity building, increased skills, high income, and more possibilities and choices in the superstructure will consciously lower their reproduction.

Okolo and Okolo (2013) claim that education and income are factors that influence the preferred family size among female health professionals in Uduth Sokoto. The key findings revealed that a total of 29 respondents (16.1%) chose religion as the factor influencing their choice of family size. Given that the majority of respondents are Muslims—a group that is known for allowing for big family sizes—and that percentage is low, it may be concluded that, while religion does have a role in determining family size among educated women; it is not a significant one. Among the respondents, only 42(23.3%) said that their educational background had influenced their decision regarding the size of their ideal family. It would have been reasonable to assume that these women's decision to have a certain family size was heavily influenced by their educational level. The survey found that 76.7% of respondents did not feel that their educational background had an impact on their choice of family size. These health professionals are aware of the hazards and issues related to having a big family size, thus they are meant to be educationally primed.

Using the 2011 Demographic and Health Survey from Ethiopia, Nigatu (2017) showed that age, education level, religion, household wealth index, use of contraception, occupation, place of residence, and whether a woman has living children were statistically significant factors

influencing the desired number of children that Ethiopian women of reproductive age would like to have in their lifetimes.

Ayele (2015) asserted that there is a considerable difference between Ethiopians living in rural and urban areas in terms of fertility levels. It's crucial to update a variety of components in order to decrease the fertility gap between the rural and urban populations. These elements might include media accessibility, career options in the modern economy, and educational opportunities. Additionally, it's critical to expand and sustain access to family planning services.

According to a study by Alfred et al. (2017), there are a number of criteria that married couples in the Kogi State University community of Anyigba, Nigeria consider when choosing a family size. The respondents' current monthly income, their religious preferences and orientations, and their level of education all had impact on their preferred family size. To put it another way, the socioeconomic circumstances of the married couples, acting alone or in concert with other influences in the university community, may influence their decision to have a certain number of children. Given the results of this study, university-based religious organizations and the various fellowship leaders should focus more on educating their members about the importance of maintaining a modest, standard, and manageable family size. No matter whose gender the family prefers, this is true.

Arthur (2005) based on their in a municipality, Ghana concluded that women would like to choose one or more children depending including culture, income, and place of residence. Family planning education initiatives had not been very effective because the majority of respondents were still not utilizing contraceptives. Those who had a better level of education had fewer families and thus gave their kids good education. It was found that the smaller families had better social and economic lives.

In a research concerning causes of educational differences in fertility among 30 sub-Saharan countries, Bongaarts (2010) discovered that women with secondary or higher education have on average lower fertility than women with no education (3.4 vs. 6.3 births per woman), which is also the case in desired family size (3.7 vs. 5.6 births per woman). The correlations between reproductive indicators alter depending on one's education level as well. Higher levels of education lead to reduced fertility at a given level of contraceptive use, higher levels of demand for contraceptives, and higher levels of demand for family size preferences. The most likely explanations for these changing patterns are that better educated women marry later frequently, use contraception more successfully, are more aware and have access to contraception, have greater control over their reproductive decisions, and are more inspired to implement demand due to the higher opportunity costs of unintended childbearing.

Muluneh and Moyehodie (2021) demonstrated that age of the woman, educational attainment, age at first marriage, religion, region, her occupation, her ideal number of children, the number

of children who are still alive, and her use of contraceptives were significant predictors of her desire for more children.

Ayehu (1998) found that women Meru people in Kenya who were married to men with higher occupation status were more likely to want to stop having children than women who were married to men with lower or middle status occupations, demonstrating an inverse relationship between the desire for more children and occupation.

The finding of Bongaarts and Casterline (2013) suggests that women in rural areas desire to have more children compared to women in urban areas. The researchers found that women living in rural environments often have limited access to contraception, reproductive healthcare services, and education. This lack of access may contribute to their desire for larger family sizes. Additionally, cultural norms and traditional gender roles prevalent in rural communities may play a role in shaping women's preference for larger families.

Razzaq et al. (2021) community-based survey in Pakistan demonstrates how the wealth quintile, education, age, the gender makeup of children, autonomy, and contraceptive use were identified as significant predictors of women's desire to limit childbirth in the future.

Islam (2020) found that modest family sizes characterize the majority of households. Those with some level of higher education have smaller families and, as a result, have educated their kids effectively. Comparing respondents with smaller family sizes to those with relatively large families, it can be seen that the former are living better social and economic lives.

CHAPTER THREE

3. DATA AND METHODOLOGY

3.1. Source of the Data

The source of the data for this study was the 2016 Ethiopia Demographic and Health Survey (EDHS). The 2016 Ethiopia Demographic and Health survey was implemented by the Central Statistical Agency (CSA) with a support from the Ministry of Health. This was the fourth Demographic and Health Survey (DHS) conducted in Ethiopia, under the worldwide measure DHS project, a USAID-funded project providing support and technical assistance in the implementation of population and health surveys in countries worldwide (CSA and ICF International, 2016).

3.2. Covariates in the Study

The response variable in the current study, Y, is a count variable that represents the number of children a woman in the reproductive 15-49 years of age wishes to have. Table 3.1 lists the covariates that could potentially predict the response.

Table 3.1. Independent Covariates and their categories.

Independent covariates	**Covariates Representation**	**Categories**
Women's age	X_1	0= 15-19
		1= 20-24
		2= 25-29
		3= 30-34
		4= 35-39
		5= 40-44
		6= 45-49
Place of residence	X_2	0= Rural
		1= Urban
Women educational attainment	X_3	0= No Education
		1= Primary
		2= Secondary
		3= Higher

Religion	X_4	1=Orthodox
		2=Catholic
		3=Protestant
		4=Muslim
		5=Traditional
		6=Others
Wealth index	X_5	0= Poorest
		1= Poorer
		2= Middle
		3= Richer
		4= Richest
Living children	X_6	0= has no living child
		1=has living child
Women occupation	X_7	0= Have Work
		1= Haven't Work
Contraceptive use	X_8	0= Used
		1= Never Used
Duration of marriage(in years)	X_9	0=Never married
		1=0-4
		2=4-9
		3=10-14
		4=15-19
		5=20-24
		6=24-29
		7=30+
Age of mother at first birth	X_{10}	0=11-15
		1=16-20
		2=21-25
		3=26-30
		4=31-35
		5=36-40

3.3. Methods of Data Analysis

3.3.1. Count regression Models

When the response or dependent variable (in this case, the desired number of children a woman would have) is count, taking on non-negative integer values, the use of non-linear models based on non-normal distribution is appropriate.

There are various count regression models such as the Poisson, negative binomial, Poisson Inverse Gaussian Model, and Zero inflated Poisson Inverse Gaussian Model.

3.3.1.1. Poisson Regression Model

Let Y be a response variable that indicates the number of relevant events. For the Poisson, the mean must be equal to the variance.

The basic of all regression models for count data is the Poisson regression model expressed as

$y_{i\sim}Pois(\lambda_i)$, with

$$p(Y_i = y_i, \lambda) = \frac{{\lambda_i}^{y_i} e^{-\lambda_i}}{y_i} \qquad (1)$$

Where, $\lambda_i = \exp(x_i^T \beta)$, $and\ \beta = vector\ of\ parameter\ estimates, and$

$x_i = [x_{i1}, x_{i2}, \dots, x_{ip}]^T\ is\ the\ \ covariate\ vector\ for\ sample\ i.$

Assuming equal dispersion

$$E[y_i|x_i] = var[y_i|x_i] = \exp(x_I^T \beta) \qquad (2)$$

The maximum likelihood (ML) method is used to estimate the regression parameters. Based on a sample of *n* independent observations, the ML function of the Poisson model is

$$\mathrm{L}(\lambda_i; x_1, .., x_n) = \prod \exp(-\lambda_i) \frac{1}{y_i!} {\lambda_i}^{y_i} \qquad (3)$$

The log-likelihood function is

$$\iota og(\lambda_i; x_1, \dots, x_n) = -n\lambda_i - \sum_i^n \ln(y_i!) + \ln(\lambda_i) \sum_i^n y_i \qquad (4)$$

The partial derivations of the log-likelihood function are taken and set to zero in order to obtain the likelihood equation for estimating the parameter.

As a result, we arrive at the first derivativesι: $\frac{\partial \iota(\beta)}{\partial \beta_i} = \sum_i^n (y_i - \lambda_i)\, x_{ij}, j = 1, \dots, p.$

In the Poisson regression modelling assumes equi-dispersion, meaning that the mean and variance are equal. However, this assumption is rarely met in practice because over-dispersion (OD) is present in most cases. The tests problem of over-dispersion is:

$$H_0: E[y_i|x_i] = var[y_i|x_i] \quad V_S \quad H_1: E[y_i|x_i] < var[y_i|x_i].$$

To detect over-dispersion, the computed values of the Deviance divided by the degree of freedom (d.f.) and the Pearson chi-square value divided by its (d.f.) must be greater than one. When these values lie in the interval (0, 1) there exist under-dispersion (UD). Note that,

1. Deviance, $D(y, \hat{\lambda})$, is given by:

   $$D(y, \hat{\lambda}) = 2 * \sum_i^n \{y_i \ln\left(\frac{y_i}{\hat{\lambda}_\iota}\right) - (y_i - \hat{\lambda}_\iota)\}.$$

In the above *n* denotes the number of observations, y the number of events, and $\hat{\lambda}_\iota$ the fitted Poisson mean **is:**

2. Pearson chi-square testχ^2, also provided by

$$\chi^2 = \sum_{i=1}^{n} \frac{(y_i - \hat{\lambda}_\iota)^2}{\hat{\lambda}_\iota}$$

Over-dispersion could exist when the sample dataset shows higher variation. This can be caused by several factors, such as sampling bias, misclassification of data, or unaccounted external factors affecting the outcome. By adding a scale (dispersion) parameter to the relationship between the variance and the mean, it is feasible to account for excessive dispersion in regard to the Poisson model.

The LRT provides a powerful means to assess if there is an over-dispersion and, if so, how severe it is. This helps to ensure that models that are fit to data are reliable and that results are correctly interpreted. The test problem regarding OD is given as:,

$H_0: \alpha = 0\ V_S\ H_1: \alpha > 0$, is used to check the presence of over-dispersion.

The test statistics would be

LR=-2LL [null-alternative]

Where LL is the log likelihood.

If the P-value of LRT (α) < α, then there are two alternatives to the Poisson. These are, NB and PIG distributions.

3.3.1.2. Negative Binomial Regression Model

The negative binomial (NB) model is one of the count data models we use when there is over-dispersion in count datasets. Over-dispersion, caused by heterogeneity or an excess number of zeros (or both) to some degree is inherent to most Poisson data. By adding an ancillary parameter into the conditional mean, NB regression model addresses the issue of over-dispersion.

When NB is used to model over-dispersed Poisson count data, the distribution can be thought of as an extension to the Poisson model. NB model uses a log link function between the response variable and explanatory covariates. The only difference between the Poisson and the NB lies in their variances, regression coefficients tend to be similar across the two models, but their standard errors can be very different.

Incorporating the use of the law of total expectation and the law of total variance,

$$E[y_i|x_i] = \exp({x_i}^T\beta)\, E[\varepsilon_i]$$

and

$$var[y_i|x_i] = E[y_i|x_i] + \frac{var[\varepsilon_i]}{E^2[\varepsilon_i]} E^2[y_i|x_i]\ .$$

This suggests that for $var[y_i|x_i] \geq E[y_i|x_i]$. The NB regression model is constructed by allowing ε_i have a prior gamma;

$$\varepsilon_i \sim gamma\left(r, \frac{1}{r}\right) = \frac{r^r}{\Gamma(r)} {\varepsilon_i}^{r-1} exp^{-r\varepsilon_i}$$

where

$$E[\varepsilon_i] = 1 \; and \; var[\varepsilon_i] = r^{-1}.$$

Thus the NB distribution is parameterized by $\mu_i = exp^{({x_i}^T \beta)}$ and an inverse parameter α (reciprocal of r) as

$$P(y_i, \mu_i, \alpha) = \frac{\Gamma(\alpha^{-1}+y_i)}{y_i!\Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1}+\mu_i}\right)^{\alpha^{-1}} \left(\frac{\mu_i}{\alpha^{-1}+\mu_i}\right)^{y_i} \quad (5)$$

$$= \frac{\Gamma(y_i + \alpha^{-1})}{y_i!\,\Gamma(\alpha^{-1})} (1 + \alpha\mu_i)^{\frac{-1}{\alpha}} \left(1 + \frac{1}{\alpha\mu_i}\right)^{-y_i}$$

$y_i \geq 0 \; and \; \alpha > 0.$

Hence we have $E(y_i) = \exp({x_i}^T \beta) = \mu_i \; and \; Var(y_i) = E[y_i|x_i] + \alpha E^2[y_i|x_i] = \mu_i(1 + \alpha\mu_i)$

If $\alpha = 0$, the NB model reduces to the Poisson regression model.

The likelihood function of the NB model based on a sample of *n* independent observations is

$$L(\mu, \alpha, y_i) = \prod_{i=1}^{n} \left\{\frac{\Gamma\left(y_i + \frac{1}{\alpha}\right)}{y_i!\Gamma\left(\frac{1}{\alpha}\right)} (1 + \alpha\mu_i)^{\frac{-1}{\alpha}} \left(1 + \frac{1}{\alpha\mu_i}\right)^{-y_i}\right\}. \quad (6)$$

The log-likelihood function ℓ of NB regression model is

$$\ell = \sum_{i=1}^{n} \left\{-\log(y_i!) + \sum_{k=1}^{y_i} (\alpha y_i - \alpha k + 1) - \left(y_i + {}^{1}/_{\alpha}\right) \log(1 + \alpha\mu_i) - y_i \log(\mu_i)\right\} \quad (7)$$

$$where\ , \frac{\Gamma(y_i + \frac{1}{\alpha})}{y_i!\,\Gamma(\frac{1}{\alpha})} = \prod_{k=1}^{y_i}\left(y_i + \frac{1}{\alpha} - k\right) = \alpha^{-y_i}\prod_{k=1}^{y_i}(\alpha y_i - \alpha k + 1)$$

For estimating regression coefficients and dispersion parameter the Newton-Raphson iteration procedure is applied like in the Poisson model.

3.3.1.3. The Sichel Model

The Sichel (SI) distribution is a compound of Poisson distribution that mixes Poisson distribution with generalized inverse Gaussian distribution. The distribution $SI(\mu, \sigma, \nu)$ has the following structure:

$$p(y|\mu, \sigma, \nu) = \frac{(\frac{\mu}{c})^y K_{y+\nu}(\alpha)}{K_\nu\left(\frac{1}{\alpha}\right) y!(\alpha\sigma)^{y+\nu}} \qquad (8)$$

$y, \mu, \sigma, \nu\ are\ response\ variable, mean, scale\ parameter, shape\ parameter\ \ respectively.$

In the above:

$\alpha^2 = \sigma^{-2} + 2\mu(c\sigma)^{-1}$,

$c = \frac{K_{\nu+1}(1/\sigma)}{K_\nu(1/\sigma)}$,

$K_\nu = \frac{1}{2}\int_0^\infty x^{\nu-1} \exp\left\{-\frac{1}{2}t(x + x^{-1})\right\} dx\ is\ the\ Bessel\ function.$

For $\sigma \to \infty$ and $\nu > 0, t$he SI distribution reduce to a NB distribution.

3.3.1.4. Poisson Inverse Gaussian (PIG) Model

The PIG distribution is a *special case* of the SI distribution in which the shape parameter is set to be -0.5. Thus, it is characterized by only two parameters. This distribution is a mixture of a Poisson distribution and an inverse-Gaussian distribution.

The main advantage of PIG distribution is that it models over-dispersed long-tail data. i.e., datasets in which there are some very large integer values far away from the majority, because it has a larger range of skewness than a NB distribution. For this model, the link of the expected value of the response variable to a set of *p* explanatory variables would be done by using a log-linear relationship. The ML method would be applied to estimate the model parameters.

Comparisons of the model performance of the NB and PIG models would be implemented by using the Akaike Information criterion (AIC), Bayesian Information criterion (BIC), and the Mean Absolute Deviance (MAD).

The goodness of fit criteria AIC and BIC are used to choose the best model. It is better to use the model with the lowest AIC or BIC value. The choice of an adequate model is frequently made using a conventional likelihood information criterion, such as the Bayesian information criterion (Raftery, 1986) or the Akaike information criterion (Akaike, 1973).

AIC = 2k-2 log likelihood

BIC = k ln (n)-2 log likelihood

Where, k = number of parameters and n = number of observations

Mean absolute deviation (MAD) is a statistical measure of the average distance between each data point and the mean of the data sets.

MAD=$\sum|x_i - \mu|/n$

Where x_i each data points, n is the number of each data points and μ is the mean of the data point.

As demonstrated by Zha et al. (2016), the overall PIG distribution denoted as PIG (μ_t, τ), is given by

$$p(y_t|\mu_t,\tau) = \frac{\left(\frac{2\alpha}{\pi}\right)^{\frac{1}{2}}\mu_t^{y_t}\exp\left(\frac{1}{\tau}\right)K_{\left(y_t-\frac{1}{2}\right)}(\alpha_t)}{(\alpha_t\tau)^{y_t}y_t!} \qquad (9)$$

$$\alpha_t = \sqrt{\frac{1}{\tau^2}+\frac{2\mu_t}{\tau}}$$

$$K_\lambda(t) = \frac{1}{2}\int_0^\infty x^{\lambda-1}\exp\left\{-\frac{1}{2}t(x+x^{-1})\right\}dx \ \textit{is the Bessel function of the third.}$$

Or

$$p(Y_t = y_t|\mu_t, \tau) = \frac{{\mu_t}^{y_t}}{y_t}(\frac{2}{\pi\tau})^{0.5}\exp\{{}^{1}/_{\tau}\}(1 + 2\tau\mu_t)^{\frac{-S_t}{2}}K_{S_t}(\alpha_t) \quad (10)$$

Where $S_t = y_t - \frac{1}{2}$

$$\alpha_t = \sqrt{\frac{1}{\tau^2} + \frac{2\mu_t}{\tau}}$$

$K_{S_t}(Y_t)$ *is the modified Bessel function of the second kind*, $t = 1, \dots, n$.

The mean and variance of the PIG distribution are

$E(y_{t)} = E\{E(y_t|\mu_t)\} = \mu_t$, $var(y_t) = \mu_t + \tau{\mu_t}^2$.

By considering the link through log-linear function,

$$\eta(\mu_t) = \log(\mu_t) = \beta x_t = \beta_0 + \sum_{j=1}^{p}\beta_j x_{tj} \quad (11)$$

The likelihood function is

$$L(\beta, \tau|y, x) = \prod\{\frac{{\mu_t}^{y_t}}{y_t}(\frac{2}{\pi\tau})^{0.5}\exp\{{}^{1}/_{\tau}\}(1 + 2\tau\mu_t)^{\frac{-S_t}{2}}K_{S_t}(\alpha_t)\} \quad (12)$$

The log-likelihood function for the parameters is

$$\iota(\beta, \tau|y, x) \propto \sum_{i=1}^{n} y_t\beta x_t - \frac{\log(\tau)}{2} + \frac{1}{\tau} - \frac{S}{2}\log(1 + 2\tau\exp\{\beta x_t\}) + logK_{S_t}(\alpha_t) \quad (13)$$

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

In this chapter, we present and discuss the findings of the current study. The open R software 4.2.2 and SPSS (Statistical Package for Social Sciences) version 23 were used for statistical analyses.

4.1. Descriptive Statistics

Descriptive results are provided in Table 4.1.

From the result, we observe that among the women we considered, the percentage of women who are in the age 25-29 have (22.4%) the highest proportions and lowest (9.2%) in 45-49.

The percentage of women attending higher (4.7 percent) and secondary (8.5 percent) education are lower than that for women attending primary (26.6 percent) or who are not educated (60.2 percent).

Furthermore, 64.1% of women were unemployed and the remaining 35.9% were employed.

In addition, 71.6% of the women were not using contraception and 28.4% were using contraception at the time of the survey.

Table 4. 1. Proportion of women by variable category

Variables	Frequency	Proportions
Women age in 5 years grouping		
15-19	359	0.035
20-24	1574	0.153
25-29	2300	0.224
30-34	2056	0.200
35-39	1805	0.176
40-44	1239	0.121
45-49	941	0.092
Living child		
living child	10144	0.987
no living child	130	0.013
Women-education level		
No education	6190	0.602

Primary	2731	0.266
Secondary	873	0.085
Higher	480	0.047
Women-currently working		
Working	3685	0.359
No working	6589	0.641
Age at 1st birth		
11-15	1661	0.162
16-20	5769	0.562
21-25	2188	0.213
26-30	524	0.051
31-35	117	0.011
36-40	15	0.001
Contraceptive use		
No used	7354	0.716
Used	2920	0.284
Place of Residence		
Urban	2732	0.266
Rural	7542	0.734
Wealth Index		
Poorest	3029	0.295
Poorer	1548	0.151
Middle	1400	0.136
Richer	1361	0.132
Richest	2936	0.286
Religion		
Orthodox	3829	0.373
Catholic	58	0.006
Protestant	1871	0.182
Muslim	4383	0.427
Traditional	73	0.007
Others	60	0.006
Cohabitation duration (years)		
Never married	120	0.012
0-4	1335	0.130
4-9	2056	0.200
10-14	2024	0.197
15-19	1812	0.176
20-24	1399	0.136

24-29	957	0.093
30+	571	0.056

The distribution of the desired number of offspring is skewed to the right and has a slightly slowly dropping tail, as represented in Figure 4.1.

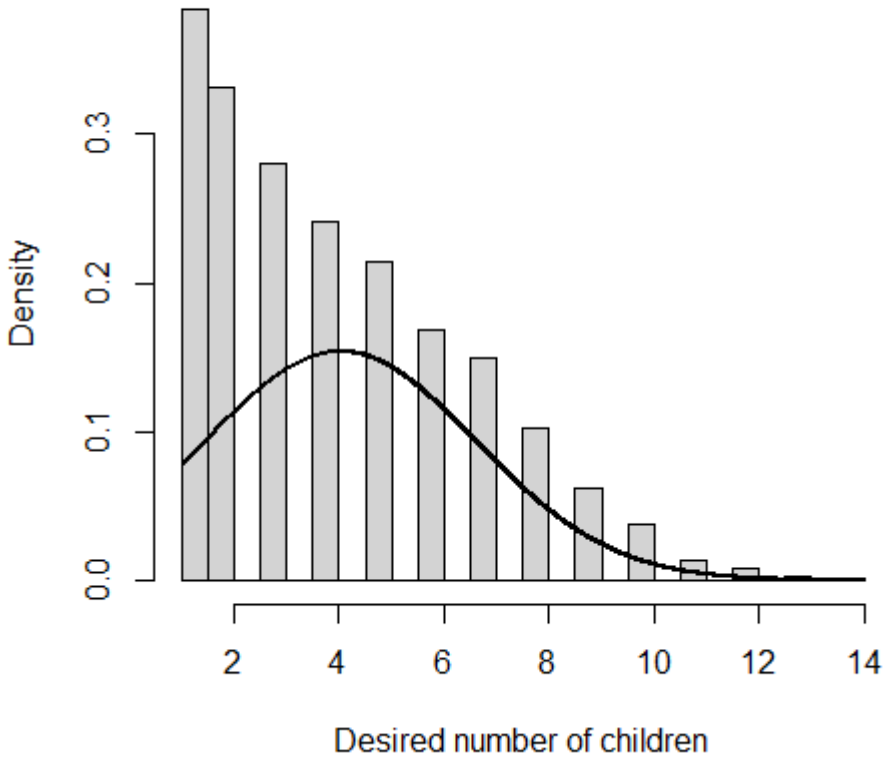

Figure 4. 1. Histogram of women's desired childbearing intentions.

4.1.1. Statistical Summary for explanatory variables

Table 4.2 provides summary data for the ideal number of children (INC) by women between the ages of 15 and 49. The average desired number of children for the entire data is 4.03.

The sample variance of the outcome variable (desired number of children), 6.726, is higher than t he empirical mean 4.029. That suggests over-dispersion, i.e. $\frac{6.726}{4.029} = 1.669 > 1$.

Table 4. 2. Mean and SD of desired number of children among women (15-49) years

Variable	Mean of INC	Std. Dev.
Total no. of children	4.029	2.593
Women age in 5 year		
15-19	1.145	0.368
20-24	1.780	0.963
25-29	2.940	1.566
30-34	4.145	2.046
35-39	5.278	2.440
40-44	5.955	2.632
45-49	6.367	2.877
Living children		
living child	1.308	0.595
no living child	4.064	2.591
Women education level		
No education	4.888	2.602
Primary	3.040	2.125
Secondary	2.186	1.463
Higher	1.931	1.213
Women currently working		
Working	4.186	2.634
No working	3.748	2.495
Age at 1st birth		
11-15	5.157	2.660
16-20	4.150	2.584
21-25	3.304	2.316
26-30	2.651	1.944

31-35	2.094	1.456
36-40	1.533	0.915
Contraceptive use		
No used	4.284	2.675
Used	3.386	2.250
Place of Residence		
Urban	2.806	1.991
Rural	4.472	2.644
Wealth Index		
Poorest	4.662	2.705
Poorer	4.353	2.462
Middle	4.329	2.545
Richer	4.421	2.656
Richest	2.889	2.067
Religion		
Orthodox	3.542	2.407
Catholic	3.879	2.493
Protestant	4.011	2.457
Muslim	4.453	2.730
Traditional	4.699	2.777
Others	4.017	2.383
Cohabitation duration in years		
Never married	1.483	1.152
0-4	1.295	0.661
4-9	2.365	1.220
10-14	3.809	1.742
15-19	4.858	2.170
20-24	5.781	2.378
24-29	6.397	2.619
30+	6.830	2.725

The descriptive summary based on Table 4.2 are explained below.

Women age: It appears that the average intended number of children correlates positively with age because it was highest (6.36) among women in the oldest age category (45-49 years) and

lowest (1.14) among women in the youngest (15-19 years). The older a respondent, the more children she believes is the optimal family size

Women with living child: In comparison to women with living children, who had an average desired number of children of 4.06, women without living children had an average ideal number of children of 1.3.

Women education: There is a definite difference between women with and without education in terms of the desired number of children. The average number of children that women who had some education wanted were lower than the average for women without education. In other words, the average ideal number of children varied between women who had never attended school and those who had completed secondary and higher education. Women without formal education wanted 4.9 children. In contrast, the average intended number of children for women with primary, secondary, and higher education was 3.04, 2.18, and 1.93, respectively.

Women occupation: Women currently working want to have more (4.18) children than those who are not paid workers (3.75).

Contraceptive use: The ideal number of children using contraception is 3.38, whereas the ideal number of mothers not using contraception is 4.28 children. Women who use contraceptives have the lowest desire for children compared to women who have never used modern contraceptive techniques.

Women age at first birth: In comparison to older mothers (36–40 years) of age, the average number of children was 1.53, and for those individuals who gave birth early (11-15) were (5.15) children.

Place of residence: The desired average number of children varied depending on where the wom en lived. In rural areas, the desired number of children was larger (4.47) than in urban areas (2.8) .

Household wealth index: The ideal desired number of children was higher (4.7) for women in the lowest income bracket and lower (2.9) for those in the top quintile, indicating that the desired number of children is inversely associated with the wealth index.

Religion: The mean ideal number of children for Orthodox Christian women (3.54) is lower than that for Catholics (3.87), Protestants (4.01), other religion (4.02), Muslims (4.45) and with traditional spiritual/traditional belief followers (4.7).

Duration of marriage: Women with longer length of time in marriage want more (6.8) children than the shorter duration, indicating that the desired number of children is directly associated with the duration of marriage.

4.2. Count Regression Model Results

4.2.1. Parameter Estimation

The three-count regression models that are used in this study are Poisson, Negative Binomial, and Poisson Inverse Gaussian. The NB regression model is favored over the Poisson model because the ratio of the Deviance and Pearson Chi-square statistic to their respective degrees of freedom is larger than one, suggesting over-dispersion in the count data (see table 4.3).

Table 4. 3. Results of over-dispersion test following Poisson regression fitting.

Statistics	Value	D.F.	Value/D.F.	P-value
Global deviance test statistic	36762.21	10239	3.5904	0.0000
Pearson Chi-square statistic	31246.34	10239	3.0517	0.0000

Furthermore, the LRT supports that the NB model is preferred to the Poisson regression model. Since this statistic has a value of 2032.49 and a p-value of 0.0001, we reject the null hypothesis of equal dispersion.

Table 4. 4. Estimated coefficients and standard error of Poisson, NB, and PIG.

Variables	PO		NB		PIG	
	Estimates $(\widehat{\beta_J})$	S.E..	Estimates $(\widehat{\beta_J})$	S.E..	Estimates $(\widehat{\beta_J})$	S.E.
Women age						
20-24	0.327	0.055	0.327	0.055	0.327	0.143
25-29	0.675	0.056	0.680	0.057	0.675	0.143
30-34	0.908	0.058	0.908	0.058	0.908	0.144
35-39	1.129	0.061	1.129	0.061	1.129	0.145
40-44	1.233	0.063	1.233	0.063	1.233	0.146
45-49	1.335	0.066	1.233	0.063	1.335	0.148
Place of residence						
Rural	0.181	0.021	0.181	0.025	0.181	0.025
Women educational status						
Primary	-0.112	0.014	-0.112	0.014	-0.112	0.018
Secondary	-0.199	0.026	-0.199	0.036	-0.199	0.036
Higher	-0.236	0.036	-0.236	0.036	-0.236	0.052
Religion						
Catholic	0.147	0.067	0.147	0.067	0.147	0.099
Protestant	0.123	0.015	0.123	0.015	0.123	0.019
Muslim	0.206	0.012	0.206	0.012	0.206	0.016
Traditional	0.150	0.055	0.150	0.055	0.150	0.075
Others	0.148	0.065	0.148	0.065	0.148	0.105
Wealth index						
Poorer	-0.053	0.015	-0.053	0.015	-0.053	0.020
Middle	-0.066	0.016	0.067	0.016	-0.067	0.021
Rich	-0.056	0.016	-0.056	0.016	-0.056	0.021
Richest	-0.161	0.022	-0.161	0.022	-0.161	0.026
Living children						
living child	0.702	0.077	0.702	0.077	0.705	0.107
Women occupation						
Working	-0.071	0.011	-0.071	0.011	-0.071	0.014
Contraceptive use						
Used	-0.008	0.012	-0.008	0.012	-0.008	0.018
Duration of marriage						
0-4	0.055	0.081	0.055	0.081	0.055	0.116
5-9	0.386	0.078	0.386	0.078	0.386	0.107
10-14	0.576	0.077	0.576	0.077	0.576	0.105
15-19	0.625	0.077	0.625	0.077	0.625	0.103

20-24	0.638	0.077	0.638	0.077	0.638	0.102
25-29	0.637	0.079	0.637	0.079	0.637	0.102
30+	0.591	0.081	0.591	0.081	0.591	0.103
Women age at 1st birth						
16-20	-0.124	0.013	-0.124	0.013	-0.124	0.017
21-25	-0.333	0.018	-0.333	0.018	-0.333	0.023
26-30	-0.578	0.032	-0.578	0.032	-0.578	0.041
31-35	-0.796	0.068	-0.796	0.068	-0.796	0.087
36-40	-1.336	0.210	-1.336	0.210	-1.336	0.268
Intercept	-0.712	0.120	-0.712	0.120	-0.712	.204

4.2.2. Goodness of fit

Selecting the most appropriate model(s) for a given study is a crucial issue in data analysis. In the current study we considered three competing count regression models namely, Poisson, NB, and Poisson Inverse Gaussian (PIG).

Model comparison standards for those fitted models are shown in Table 4.5. Boldface values represent the smallest values. Since the AIC, BIC, and MAD values are smallest for the PIG, we consider it as the most appropriate model among the considered models.

Table 4. 5. Model-comparison criteria for desired number of children.

Models	**AIC**	**BIC**	**MAD**
Poisson	36832.21	37085.52	3.590412
NB	36834.21	37094.76	3.590761
PIG	**36762.54**	**37023.09**	**3.583761**

Table 4. 6. Estimates for PIG model for selected independent covariates

Variables	Estimate ($\widehat{\beta_J}$)	S.E.	t-value	Pr(>|t|)	IRR
Women age					
15-19	**(ref)**				
20-24	0.327	0.143	2.282	0.022518 *	1.387
25-29	0.675	0.143	4.703	2.59e-06 ***	1.964
30-34	0.908	0.144	6.303	3.04e-10 ***	2.479
35-39	1.129	0.145	7.800	6.82e-15 ***	3.093
40-44	1.233	0.146	8.435	< 2e-16 ***	3.431
45-49	1.335	0.148	9.039	< 2e-16 ***	3.801
Place of residence					
Urban	**(ref)**				
Rural	0.181	0.025	7.386	1.63e-13 ***	1.199
Women education level					
No education	**(ref)**				
Primary	-0.112	0.018	-6.265	3.89e-10 ***	0.894
Secondary	-0.199	0.036	-5.508	3.72e-08 ***	0.820
Higher	-0.236	0.052	-4.506	6.68e-06 ***	0.790
Religion					
Orthodox	**(ref)**				
Catholic	0.147	0.099	1.484	0.137784	1.159
Protestant	0.123	0.019	6.304	3.02e-10 ***	1.131
Muslim	0.206	0.016	13.225	< 2e-16 ***	1.228
Traditional	0.150	0.075	2.012	0.044226 *	1.162
Others	0.148	0.105	1.412	0.157843	1.160
Wealth index					
Poorest	**(ref)**				
Poorer	-0.053	0.020	-2.607	0.009154 **	0.949
Middle	-0.067	0.021	-3.138	0.001706 **	0.935
Richer	-0.056	0.021	-2.672	0.007552**	0.946
Richest	-0.161	0.026	-6.163	7.40e-10 ***	0.852
Living children					

no living child	**(ref)**				
living child	0.702	0.107	6.529	6.94e-11 ***	2.017
Women currently working					
Not working	**(ref)**				
Working	-0.071	0.014	-5.162	2.49e-07***	0.931
Contraceptive use					
No used	**(ref)**				
Used	-0.008	0.018	-0.446	0.655461	0.992
Cohabitation duration					
Never married	**(ref)**				
0-4	0.055	0.116	0.477	0.633667	1.057
4-9	0.386	0.107	3.621	0.000295 ***	1.472
10-14	0.576	0.105	5.505	3.78e-08 ***	1.779
15-19	0.625	0.103	6.073	1.30e-09 ***	1.868
20-24	0.638	0.102	6.248	4.33e-10 ***	1.893
25-29	0.637	0.102	6.229	4.88e-10 ***	1.890
30+	0.591	0.103	5.738	9.87e-09 ***	1.806
Age at 1st birth					
11-15	**(ref)**				
16-20	-0.124	0.017	-7.527	5.62e-14 ***	0.883
21-25	-0.332	0.023	-14.390	< 2e-16 ***	0.717
26-30	-0.578	0.041	-13.999	< 2e-16 ***	0.561
31-35	-0.796	0.087	-9.096	< 2e-16 ***	0.451
36-40	-1.336	0.268	-4.980	6.47e-07 ***	0.263
Intercept	-0.712	0.204	-3.496	0.000474 ***	0.490

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

4.2.3. Discussion and interpretation of PIG model fit results

The coefficients in table 4.6 show the estimated PIG count regression model fit results. The interpretation is as follows. For every one unit increase in a unit of the relevant predictors, the PIG model predicts that the log number of intended children will rise or fall by about the appropriate coefficient in the column of coefficients. The variables in this model with p-values less than 0.05 were deemed statistically significant. It is crucial to analyze the categorical data produced by the *incidence rate ratios* ($IRR = exp(\widehat{\beta j})$) in order to understand the change in the proportion ($IRR - 1$) of relevant predictors.

Women age: The age category of women influences the expected number of children that women in the non-zero group would want to have. All the predicted coefficients for women are positive and statistically significant for all age groups. Holding all other model variables constant, the expected desired number of children that women aged (20-24) would like to have in the reproductive age been 1.387 times more likely to have a desired number of children that woman aged (15-19) would like to have in their lifetime. To put it another way, the expected desire for children among women in the 20–24 years age group was 38.7% more than the expected want for children among women in the 15–19 age group. Holding all other model factors constant, women aged 25–29, 30-34, 35–39, 40–44, and 45–49 are predicted to have, respectively, 96.4%, 47.9%, 9.3%, 43.1%, and 80.1% more children than women aged 15–19.

Therefore, depending on the age group of the woman, different numbers of children are desired. Age differences show that the aged group (45-49 years) is the age group with the highest proportion of desired children, while the young adult age group (20–24 years) is the age group with the lowest proportion of desired children. Findings by Muluneh and Moyehodie (2021) are comparable to those from this study.

Place of residence: The desired number of children varies depending on where women are living. For the rural, the coefficient is positive and statistically significant, indicating that women in rural areas have a 19.9% higher incidence rate of having desired number of children during their reproductive age, compared to the women in urban areas. Similar to findings of this study Bongaarts and Casterline (2013) show that woman in rural areas of sub-Saharan Africa had higher desired fertility compared to women in urban areas.

Women education: The primary education coefficient is statistically significant and negative in the fitted PIG model. As a result, women with primary education are predicted to have 10.6% fewer children overall than women without education (IRR=0.894). The coefficients are also negative and statistically significant for both secondary and higher education. The findings show that, after adjusting for other model variables, women with secondary and higher education are predicted to have 18% and 21% fewer children overall than women without education. These findings concurred with those by Islam (2020) that women with some level of higher education have smaller families and, as a result, have educated their kids effectively.

Women religion: Protestant, Muslim, and Traditional religious categories each have positive and statistically significant coefficients. According to the IRR, Protestant, Muslim, and Traditional faith adherent women are expected to have 13.1 percent, 22.8 percent, 16.2 percent, more children than Orthodox women respectively. There was no significant difference in the desired number of children that women would like to have between Catholic, others religion and Orthodox women. Our finding is similar to that of Nigatu (2017) which show no significant influence of religion.

Household wealth index: The coefficients for the wealth index categories for the poorer, middle, richer, and richest people are all negative and statistically significant. Women in the poorer index are predicted by the IRRs to have 5.1 percent fewer children than women in the poorest index. Women in the Middle, Richer, and Richest Wealth Indices are also predicted to have 6.5 percent, 5.4 percent, and 14.8 percent fewer children than women in the Poorest Wealth Indices respectively. Therefore, among women in all wealth index categories, those with the highest wealth index are predicted to have the fewest number of children, demonstrating that fertility is inversely connected with wealth index. Alfred et al. (2017) research reveals similar results to that of this study.

Living children: The desire for children among women with living children is expected to be 1.7 percent higher than the desire for children among women without children in their lifetimes, according to the positive and statistically significant value for this group of women.

Women occupation: The computed coefficient for women's employment is negative and statistically significant. Working women's estimated negative coefficient, -0.071, indicates that they should anticipate to have 6.9 percent fewer children overall than jobless women (IRR=0.931). Compared to unemployed/not working (not paid) women, women who are employed/working had a lower average desire for more children.

Contraceptive use: There was no significant difference in the desired number of children that women would like to have between women who used contraceptives and women who didn't. This outcome was at odds with the study conducted by Razzaq et al. (2021).

Duration of marriage: The coefficients for the duration of marriage categories are positive and statistically significant, except for category 0-4. An incidence rate ratio of (1.472) for women who have been married for 4 to 9 years suggests that they are 1.472 times more likely to want having more children than women who have never been married. Likewise, women who lived with their partner for 10 to 14, 15 to 19, 20 to 24, 25 to 29, and 30 years or more are likely to have 77.9%, 86.8%, 89.3%, 80.6%, and 89% more children than women who have never been married. There was no significant difference in the desired number of children that women would like to have between women who lived together with their partner for 0 to 9 years and women who have never been married.

Age of mother at first birth: The coefficients for the predictor variable age at first birth of women are negative and statistically significant. It is predicted that the desire for children among women who give birth early, between the ages of 16 and 20, will be 11.7 percent lower than the desire for children among women who give birth between the ages of 11 and 15. Similarly, holding all other model covariates constant, women who gave birth in the age of 21-25, 26–30, 31–35, and 36–40 are predicted to have 28.7%, 43.9%, 54.9%, and 73.7% fewer children than women aged 11–15.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study aimed to find and examine significant covariates that could affect Ethiopian women's desire to limit the number of children in reproductively active period of 15-49 years using a count regression model. The data in the analyses were taken from the 2016 Ethiopian Demographic and Health Survey (CSA and ICF International, 2016). Compared to the considered three count models, the Poisson inverse Gaussian regression model (PIG) was identified as the most suitable and recommended model. The predictor variables in this study that significantly impacted the desired number of children were reported.

The PIG model fit results showed that age of women, place of residence, level of education of women, religion of women, household wealth index, whether a woman has living children, occupation of women, duration of marriage and women age at first birth were statistically significant covariates influencing the desired number of children that Ethiopian women would like to have when they were reproductively years of age.

5.2. Recommendations

In light of the results we have found we suggest the following concerns:

1. *Targeted intervention:* The study identified several covariates that affect the number of desired children. Policy makers may want to consider targeted interventions that address those specific covariates in order to reduce the number of desired number of children in areas where desired family size is higher.
2. *Continued monitoring*: Sustained a continuous monitoring of fertility rates and trends is important to inform/formulate policy decisions. Additional survey and studies could be conducted to provide updated data and identifying any emerging trends or changes in factors affecting the number of children.

References

Akaike, H. (1973). Information Theory and an Extension of the Maximum Likelihood Principle. Pp. 267–281 in Second International Symposium on Information Theory, edited by B. N. Petrov and F. Csaki. Budapest: Akademiai Kaido.

Alfred, Eboh and Oremeyi Akpata Grace and Owseni, JS. (2017). Socio-economic impact of family size preference on married couples in Kogi State University community, Anyigba, Kogi State, Nigeria. *Am J Sociol Res*, 99-108.

Arthur, J. L. (2005). Family size and its socio-economic implications in the Sunyani Municipality of the Brong Ahafo Region of Ghana, West Africa. *Ghana: Center for Development Studies , Faculty of Social Science, University of Cape Coast*.

Ayehu, T. (1998). *Correlates of fertility preference of Kenyan women: Evidence from Kenya Demographic and Health Survey.Unpublished Msc thesis.* . University of Nairobi.

Ayele, D. G. (2015). Determinants of fertility in Ethiopia. *African health sciences*, [546-551].

Azumah, FD and Adjei, EK and Nachinaab,JO. (2017). The effects of family size on the investment of child education, case study of Atonsu-Buokro, Kumasi. *Research journalis Journal of Sociology*, 2374-8241.

Bairagi, R. (2001). Effects of sex preference on contraceptive use, abortion and fertility in Matlab, Bangladesh. *International Family Planning Perspectives*, [137-143].

Becker, G. (1976). *The economic approach to human behavior.* The University of Chicago press.

Becker, G. (1991). *A Treatise on the Family, Revised and Enlarged Edition.* . Cambridge: Harvard University Press.

Bhargava, A. (2007). Desired family size, family planning and fertility in Ethiopia. *Journal of biosocial science*, 367-381.

Bongaarts, J. (2010). The causes of educational differences in fertility in Sub-Saharan Africa. *Vienna yearbook of population research*, [31-50].

Bongaarts, J., and Casterline, J. (2013). Fertility Transition: is sub-Saharan Africa different? *Population and Development Review*, [153-68].

Central Statistical Agency (CSA) [Ethiopia] and ICF (2016). Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA.

Centeral Statistical Agency (CSA) and ICF International (2012). Ethiopia Demographic and Health Survey 2011. CSA, Ethiopia and ICF International, Calverton, Maryland, USA.

Dibaba, Bekele and Mitike, G. (2016). Factors influencing desired family size among residents of Assela Town. *J Women's Health care*, 1-8.

Dibaba, Y. (2009). Factors influencing women's intention to limit child bearing in Oromia, Ethiopia. *Ethiopian Journal of Health Development*.

Gebremedhin, Samson and Betre, Mulugeta. (2009). Level and differentials of fertility in Awassa town, Southern Ethiopia. *African Journal of reproductive health*.

Gurum,Eshetu and Mace, Ruth. (2008). Fertility decline driven by poverty: the case of Addis Ababa, Ethiopia. *Journal of bioscocial Science*, 339-358.

Hyeladi, A., & Alfred, J. (2014). Assessment of family sizes and poverty levels in Mangu LGA, Plateau State. International Journal of Humanities and Social Science, 4(3), 310- 314.

Islam, M. J. (2020). Factors influencing family size: a critical study on Khulna district of Bangladesh. *Br. J.Arts Humanit*, [73-81].

Kinfu ,Yohannes and others. (2001). *An analysis of the change toward below-replacement-level fertility in Addis Ababa.* The Australian National University.

Muluneh, Essey Kebede and Molla, Habitu Liyew (2022). Factors influencing desired number of children among Ethiopian women: Application of count regression models. *Ethiop. J. Sci. & Technol*. 15(2): 141–154.

Muluneh,Mitiku Wale and Moyehodie, Yikeber Abebaw. (2021). Determinants of desire for more children among women in Ethiopia. *BMC Women's Health*, 1-7.

Nigatu, D. (2017). Factors Associated with Number of Children that Women in Ethiopia Would Like to Have in their Lifetime (Application of Count Regression Model). Addis Ababa University.

Ojo, Stephen S and Adesina, Ayesoro Sunday. (2014). Women empowerment and fertility management in Nigeria: a study of Lafia area of Nasarawa State. *Mediterranean Journal of Social Science* , 9.

Okolo, NC and Okolo, CA. (2013). Factors Influencing the Choice of Family Size amongst Female Health Professionals in Uduth Sokoto. *International Journal of Social Science and Humanities Reviews*, 159-166.

Raftery, A.E. (1986). Choosing models for cross-classification: A Bayesian approach. Journal of the royal statistical society: Series B (Methodological), 48(3), [529-546].

Ramesh A. (2010). *Demographic, socio- economic and cultural factors affecting fertility differential in Nepal.* Kathmndul: Geography and Population Department Tribhuvan University.

Razzaq,Shama and Jessani, Saleem and Ali, Sumera Aziz and Abbasi, Zahid and Saleem, Sarah. (2021). Desire to limiting child birth and the associated determinants among married females: Sukh Survey-Karachi, Pakistan. *JPMA. The Journal of the Pakistain Medical Association.*, S70.

TGE(1993).National Population Policy of Ethiopia. Transitional Government of Ethiopia. Addis Ababa,Ethiopia.

Thomson, E. (2015). Family size preferences. (In: International Encyclopedia of the Social & Behavioral Sciences, ed. James D. Wright). Elsevier, pp.805-808.

Uddin, Md Emaj and MSS, Tanzima Zohra Hobib and MSS, Md Sayeed Akhter. (2012). Socio-cultural factors affecting family size between muslim and santal communities in rural Bangladesh. *Cultural Anthropology*, 410.

Zha, L., Lord, D. and Zou, Y. (2016). The Poisson inverse Gaussian (PIG) generalized linear regression model for analyzing motor vehicle crash data. *Journal of Transportation Saftey and Security*, [18-35].

`