



**LUND UNIVERSITY**  
School of Economics and Management

**Master programme in Economic Demography**

**Female Genital Mutilation in Senegal**  
**The role of Socio-Economic Risk Factors of Circumcision and**  
**Subsequent Effects of Circumcision upon Fertility and Marriage**  
**Markets**

**James Austen**  
[ede14jau@student.lu.se](mailto:ede14jau@student.lu.se)

*Abstract:* Female Genital Mutilation is widespread in sub-Saharan Africa despite being illegal in many countries. It has been shown in previous research that female genital mutilation occurs due to long standing tradition which creates difficulty in the elimination of the practice. In any case, the effects of mutilation can have long lasting effects on future demographics through impacts on future fertility and marriage markets. This study looks to identify socio-economic risk factors that can increase the risk of circumcision of respondent first daughters in Senegal using Demographic Health Survey data. Marriage Markets are affected through a number of channels due to the existence of female genital mutilation. For example, circumcision is associated with preparation for marriage reducing the age of marriages within populations. Furthermore, female circumcision can be used as a mechanism of control for women under the male dominated household, causing circumcision status to effect potential value on the marriage market assuming men supposedly make rational decisions when choosing a wife. Additionally, the practice can have negative impacts on female health, leading to the assumption that fertility will be negatively affected. Literature on the subject of female circumcision is growing, however few address the issue in relation to economic theories of circumcision. Likewise, much of the quantitative literature on female circumcision disregard the severity of circumcision. This paper attempts to link the severity of circumcision to fertility impacts through measurement of birth parity spacing and total births.

*Key words:* Female Genital Mutilation, FGM, Circumcision, Senegal, Fertility, Marriage Markets, Risk Factors, Cox Proportional Hazard

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# Economic Risk Factors of Female Genital Mutilation and Impacts on Fertility and the Marriage Market in Senegal.

## 1. Introduction

An estimated 125 million females alive today have undergone Female Genital Mutilation (FGM). FGM refers to the procedure of intentionally altering the female genital organs for non medical reasons. Female circumcision is most commonly carried out in the Middle East and Africa where it has traditionally been regarded as a social norm. While most commonly concentrated in Africa and the Middle East, the practise is increasingly finding its way into immigrant population in the Western World. The procedure involves a sharp object, for example a stone, blade to remove parts of the female genitalia, which is rarely accompanied with anaesthesia. Often, the procedure is performed on consecutive girls in the same period using the same unsterilized tool. Complications include severe pain, bleeding, infertility, and problems relating to childbirth. In addition, there is a heightened risk of HIV transmission due to the non sterile environments in which FGM procedures are carried out.

Recognised internationally as a violation of human rights, FGM reflects deep rooted inequality between sexes and is a form of gender discrimination. The practice violates individuals right to health, security, physical integrity, the right to be free from inhuman torture and degrading treatment. (WHO, 2015). Despite FGM having seen reduction in popularity with chances of a girl being cut being one third less than 30 years ago, FGM is still exists. The practise is still widespread, remaining universal in countries such as Somalia, Egypt, Djibouti. The country of Senegal which is the focus of paper has seen efforts made to recognise the harmful impacts of FGM with the practise being criminalised in 1999. Despite, the knowledge of the illegality of the act, FGM is a social norm in Senegal and is required in the guarantee of cultural and social acceptance. Many Senegalese women believe that FGM is beneficial for cleanliness, aids marriage, retains virginity as well as being a religious requisite. An estimated 25.7% of Senegalese females age 15 to 49 have undergone FGM (DHS MICS, 2001). The rate of rural FGM is higher at (27.8%, 23.4%) compared to urban areas. Most Senegalese live in rural areas with the south seeing particularly high prevalence rates (Kendougou, 92%) (Matam, 87%) (Sedhiou, 86%) (DHS, MICS, 2010). In the capital Dakar which contains 49% of the urban population, prevalence rates are at 20.1%.

It is assumed that there are a range of factors that influence the risk of females being exposed to FGM. Factors include Socio-Economic, Familial, Geographical and Educational backgrounds. Likewise, it is thought that consequences of FGM can result in changes to both fertility and marriage markets.

Empirical evidence linking marriage, fertility and FGM are limited and varies regarding their results. In particular, there are few studies that use severity of circumcision as a variable rather instead choosing a binominal variable (Circumcision Status: Yes or No) mainly due to data restrictions. The dataset which this study uses, contains information allowing for a severity index to be created. This study allows the opportunity to look into the deeper effects of FGM on fertility and marriage. Exploring the links between fertility and the marriage market can contribute towards policy relating to a number of issues. These include international development and predictions of labour force outcomes for the future. Due to fertility being a central component in these fields, FGM could be seen as an important channel for which fertility can be influenced.

## 2. Research Question

This study will be divided into two parts. The first part of this study aims to further knowledge of the links between FGM and socio-economic risk factors in Senegalese society. It is presumed that demographic and socio economic circumstances will impact the likelihood of parental circumcision decisions. This research will attempt to create concrete links on the strength of socioeconomic and demographic variables in relation to FGM occurrence as well as the testing of economic theories on the effects of familial structures in the FGM tradition.

The second part of this study deals with the links between FGM marriage and fertility. Fertility is extremely high in some African nations with high incidences of FGM. This research paper further aims to investigate into the severity of FGM upon fertility and marriage, previously underexplored in current research. Aims of this thesis are to find a clear connection between FGM and fertility and marriage market which can consequently have impacts upon future demographics. To summarize, the following research questions will be investigated.

- How do Socio-Economic variables affect the risk of FGM occurrence?
- How do familial ties and structures relate to FGM occurrence?
- What are the impacts of FGM on the Marriage Market measured through age of first-cohabitation?
- Does FGM incidence and Severity effect on Fertility levels measured through time between first and second birth parities and total number of Children born?

### 3. Background Information

#### 3.1 Senegal: A Geographic & Demographic Overview

The West African nation of Senegal is bordered by Guinea-Bissau to the South, Guinea to the south-east, Mauritania to the north and Mali to the east. The Gambia is a virtually interlocked country within Senegal that follows the Gambie River. The surface area of Senegal is 196,722 square kilometres and features a relatively flat topography consisting of sandy planes of the Sahel. Currently, Senegal is divided into fourteen administrative regions, of which Dakar the capital is the most heavily populated with over 3 million inhabitants (Figure 1). The total population of Senegal is 14.95 million with a density of 68.7 inhabitants per square kilometre. The median age of Senegal stands at 18.4 years of age.

Figure 1: Geography of Senegal and Administrative Regions of Interest (Figure: Adapted from National Geographic, 2016)



French, the official language of Senegal inherited from its colonial past is spoken fluently by around ten percent of the population. Other more widespread national languages include Balanta-Ganja, Hassaniyya, Jola-Fonyi, Mandinka, Mandjak, Mankanya, Pulaar, Serer, Soninke, and Wolof the most widely spoken language. The wide range of ethnic groups make Senegal one the most ethnically diverse countries of comparative size. The major ethnic groups in order of size are Wolof (43%), Fula (24%), Serer (15%) and Jola (5%). Smaller ethnic groups exist and include Soninke, Mandinka. Islam (sunni)

is the overwhelming predominant religion of the country whilst Christianity exists in a much smaller proportion. Islam has shaped and molded much of Senegal's culture and society. Life expectancy stands currently at 63 years and has been rising steadily since increases in healthcare reducing infant mortality levels. Total Fertility rate was 4.52 births per woman in 2014. Infant mortality is 60 (per 1000) while maternal mortality is 320 (per 100,00 live births). HIV prevalence is relatively low at 0.5% of the adult population. Overall literacy rate in Senegal is 52% with a clear divide over genders (Female, 38.7%)(Male, 61.8%) (Unicef, 2013).

### **3.2 Senegal: Culture & Women's Status**

The interlinked nature of religion and culture in Muslim countries relates to how deeply embedded social attitudes and practises have resulted in creation of informal social norms. Although no religion prerequisites FGM, data from the Senegalese Standard DHS 2010-2011 suggests that 22.8% of respondents believed that FGM was a religious requirement. This figure rises when looking at other countries as shown by Von der Osten-Sacken (2011). Senegal has gradually been Islamised since the nineteenth century and today around ninety percent of the population is Muslim. Religious ruling, most notably Islam have always seen women misrepresented in power roles. The important religious titles of Serigne, Thierno and Marabat are never given to women despite the religious intellect of the individual. The status of women is an issue deep rooted in culture and society, bringing together the ideas of religion, "africaness" and westernisation (Sow, 2003). Furthermore, the conflict between modernity and Islam has created difficulties in the progression of women's rights. Fundamentalist views would be for nothing to change referring to the status of a woman providing that a woman is a symbol of ethnic purity. Despite, fundamentalist Islamic belief, women in Senegal are rapidly gaining access to education, allowing intellectual freedom and presenting a challenge to the traditional hierarchy of power.

The empowerment of Senegalese women is relatively strong compared to comparable Muslim African nations. Under the general principle that women should be of lower status to men, the importance of the individual is important in Senegalese culture, giving women some level of bargaining power in the household. A number of laws have shown that the Senegalese government is committed to a transformed state based on an increasingly modern outlook. The family law code of 1973 has been aimed towards Senegalese of all ethnic groups criminalising underage marriage but still giving authority to the male of the household (Boye, 1991). The Penal Code 1999, has criminalised domestic violence and rape, however spousal rape is not recognised (Niang, 2009). Despite FGM being made illegal, it is still prevalent but authorities seem to be challenging development goals by working with NGOs to abandon the practise.

### 3.3 Polygamy in Senegal

The most common pattern of marriage in Senegal is polygamy, a state where one man is married to several women. French colonial influence in Senegal failed to overthrow the existence of polygamy for civil marriages due to the legislation widely being rejected in both cities and rural areas in favour for traditional or religious custom. In fact, today Senegal has the highest rates of polygamy in Western Africa, with around half of married women in a union with a polygamous husband. Younger women also seem to be engaged in polygamous marriages with a twenty-five percent rate for polygamy rates amongst 15-19 year olds. Social factors that have lead towards a tendency for polygamous marriages are a mixture of religious and demographic circumstances. The Islamic law allows for men to have more than one wife, which many of them use to explain their polygamy practise. Additionally, the desire for a high number of children is a strong influencing factor for the existence of polygamy. Around 40 percent of married men in Senegal have more than one wife. The average number of wives per married man is 1.5, although Islamic law allows for marriage to up to four wives.

The high number of ideal children in Senegal is fuelled by both a historically and current high level of child mortality. Polygamy in general, increases the number of children men can obtain, which gives rise to the number who will survive to the productive working years. The higher the number of offspring, the higher the level of old age security through upward intergenerational transfers. These transfers (labour & economic) are high due to the fact that rural areas of Senegal contain the majority of the population, providing an increased incentive to have a large number of children who will mainly be working in familial agriculture. Polygamist marriage structures, both can have a strong effect of fertility and marriages, through changes in the regularity of intercourse as well as age of marriage, showing its importance of the variable in this study's regression specifications. On an aggregate level, polygamy has been seen to cause higher fertility levels, however women who are in polygamist marriages seem to have less children, mainly due to the fact of reduced sexual intercourse and the older age of their husbands (lower fertility) (Garenne, 1989). Economic Theory on polygamy also suggests that there is a positive income effect (Becker, 1974, 1986). Becker has a simplistic view on fertility proposes that the more parents care about their children the more altruistic they are. This altruism is shown through the amount of capital they receive in inheritance which will effect their standard of living. Furthermore, depending on how altruistic attributes are distributed amongst wives, beneficiaries to children of each wife will vary effecting fertility decisions. A Senegalese study by Rossi (2015) also showed that wives in a polygamous marriage raise their fertility rate when other wives also raise fertility rates, indicating reproductive rivalry between spouses.

Finally, levirate occurs in Senegal which aids polygamy through widows remarrying the brother of the deceased husband out of tradition. The presumption that polygamy can reduce fertility levels makes

the issue relevant when studying the marriage market. The marriage market and fertility is strongly linked, especially in countries where non-marital sex is uncommon.

### 4. Female Genital Mutilation (FGM)

The practise of FGM, which involves removing healthy tissue effecting the normal function of the female body holds no known health benefits (Sauer, 2014). Both short term and long term difficulties can occur in the form of passing urine, menstruation, infections, sexual intercourse, birth complications as well as possible psychological trauma (Andro, 2014). The procedure is always traumatic and can lead to post traumatic stress disorder and depression.

Haemorrhage is an issue for circumcised woman due to scar tissue present which can potentially tear during the birth of a child (McSwiney, 1992). Furthermore, to aid delivery of a child, an episiotomy may be needed where a cut between the anus and vagina is needed or even a caesarean. Senegal does not have a developed health care system meaning that many of these interventions come with a higher risk of death. The fact that FGM is usually carried out by ‘traditional circumcisers’, creates a dangerous combination of risk factors to female health (Kiragu, 1995). Risk factors include the use of non-medical equipment (scissors, razor blades, broken glass) and the multiple cutting of many girls in one time increasing the risk for cross contamination of HIV (Kun, 1997). Increased infection rates in regards to FGM are observed due to open areas being created left susceptible to harmful bacteria. Menstruation periods are also particularly vulnerable for women as this increases the risk of disease transmission. (Tinker, 1998) There is the belief that many women do not seek treatment for the short and long term problems associated with circumcision due to FGM being a cultural tradition along with the widespread belief of health outcomes being related to witchcraft and God’s will.

FGM can take many forms and can vary in severity. The WHO (2008) outlines the types of FGM as the following.

Type I — Partial or total removal of the clitoris and/or the prepuce (clitoridectomy).
Type II — Partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora (excision).
Type III — Narrowing of the vaginal orifice with creation of a covering seal by cutting and appositioning the labia minora and/or the labia majora, with or without excision of the clitoris (infibulation).
Type IV — All other harmful procedures to the female genitalia for non-medical purposes, for example: pricking, piercing, incising, scraping and cauterization.

## 5. Previous Research

In countries where circumcision is practised, FGM is regarded as a rite of passage from childhood to adulthood. The procedure is a sign of sexual ripeness and readiness for marriage (Assad, 1980). Njambi (2004) marks the ritual as a demonstration of bravery when a female does not cry during the process. Circumcision also serves as social puberty signifying the passage into sexuality (Gordon, 1991). Likewise, circumcision also serves as preparation for the female's role as a bride (Kennedy, 1970). Other lines of thought consist of circumcision being part of the female identity, where social benefits outweigh the medical dangers (Dirie & Lindmark, 1991). The fact that circumcision can play a part of attainment of the full female identity, it acts also as a guarantee for family honour, virginity, chastity, purity and marriageability (Hayes, 1975; Kouba & Muasher, 1985). Attitudes towards FGM are also a strong indication of the risk of circumcision. In a Somali study by Momoh (2004), views on why FGM was practiced ranged from higher dowry prices, traditional and religious norms, as well as protection from rape. Furthermore, attitudes from husbands suggest a large proportion of men would not marry uncircumcised women due to their own ideology of how a woman should be (Missalidis, 2000).

(Hosken, 1981:11) *"Infibulation is quite clearly intended to assure the husband that his wife which is his property (he has bought her for an often staggering bride-price) produces his children. She is simply a means to have sons. Virginity in a girl is of prime importance such a setting"*.

It is of course, intuitive that cultures differ over demographic and familial attributes, therefore leading to interest into studies into the trends that are occurring over time and space. In a study of worldwide demographic characteristics of the FGM practice, it is summarized that circumcision generally occurs in high fertility, high mortality countries with young populations (Liang et al, 2016). The majority of FGM affected countries are the least developed with high level adolescent birthrates. Niger, Chad and Mali have the highest incidence of adolescent birth rates when compared to total fertility rates. Senegal currently sits at around double the worldwide of average of adolescent births (Singh, 1998). From an urbanisation perspective, most FGM affected countries were less urbanized than others in the region (Khafagi, 2001). The benefits of urbanization include the abandonment of FGM, because families and women in gain better education and access to services encouraging change of norms and associated with FGM. The challenge becomes how to reap the benefits of urbanization in advancing the elimination of FGM (Liang et al, 2016).

The consensus on the relationship between FGM and marriage is that FGM is seen as a signal for society that an individual is prepared for the marriage market. Pre-marital confinement mechanisms have taken various forms over the years, and remain a large part of life in many areas of the world. It

is estimated that 50-80 percent of girls underwent foot-binding in the mid eighteenth-hundreds (Levy, 1966). Although the foot-binding practise is near enough eradicated other forms of pre-marital confinement continue to exist. Mackie (2000), contends that FGM is a mechanism for which is upheld through the exogenous expectations of the labour market. Due to universal thoughts on what is to be expected of brides are in place it becomes very difficult to deviate from this norm. Those who fail to comply with the norm will also fail to marry and thus reproduce. Parents who wish to increase their daughters value as brides would enforce FGM as an avenue to better marriage prospects. Rai (2007) suggests that parents 'discipline' their daughter's behaviour to match value maximising characteristics on the marriage market, of which circumcision is regarded strongly for 'premarital confinement'. In contrast men have a preference for fidelity (Dickemann, 1981), where the underlying assumption is that perfect information is not available on women's characteristics. The asymmetrical information between women and men produce a male preference towards women who are perceived to be potentially more faithful. FGM is also seen as a mechanism to control the female sexuality will signal fidelity to males (Naguib, 2012). Fidelity is a symbol of value of the marriage market and males will be more inclined to choose a circumcised bride to be. The impact of belonging to a social network can cement circumcised women into their communities by creating a division between themselves and the 'other' (Little, 2003). Divisions may emerge from the result of stereotypes of circumcised and uncircumcised women (Ouedraogo, 2008). Beliefs of the benefits of circumcision held by the circumcised group can include cleanliness, preventing promiscuity and disease and easing child birth can be held as critique of uncircumcised women. Many women also believe that FGM is essential for preserving virginity which is also attractive on the marriage market further increasing the reasons for excluding others from the social group (Isman, 2013).

The idea that FGM operates as a signal of social capital accumulation which exudes prestige and power of elders was discusses by Shell-Duncan & Wander (2011). Ahmadu (2005) also notes that FGM is closely tied to women's power among Mande groups in West Africa. "far from being oppressed by excision rituals, women are the organizers, the champions, and staunch defenders of these practices and, importantly they strategically manipulate and exploit gender ideologies as well as gender asymmetries", The FGM practice is therefore used as to strengthen the structural hierarchy of female elders and cultural FGM practices trickle down generations. Elder women are often more wealthy and have established social networks than younger women and less likely to rely on others for social or material support. A younger woman who wishes to be part of the social network will want to obtain to elder female cultural traditions and be obedient which will increase power and standing of elders in the social network. Essentially, the communal expectations of FGM will be self-enforcing due to the assumption that other girls will be circumcised as well as the need to be included in the social group which works in an inter-generational manner. Mackie (2013) agrees that for FGM to be abandoned a

large mass of people would need to shift their FGM habits to allow for uncircumcised women to marry. However, FGM can also be associated with a variety of other factors that vary with culture. For example, religious and female initiation can be related with FGM creating further links other than what arose from a marriage convention.

Although, the majority see FGM as signalling mechanism for the marriage market, others have cast doubt on this theory. DHS data from Guinea suggests that beliefs about FGM were not directly related to the marriage market. The study by Gage and Van Rossem (2006) demonstrated that support for discontinuation of FGM was negatively related to increased marriageability. Guinea has a situation where circumcision is almost universal for women. Under the assumption that FGM reduces sexual pleasure and the desire for sex, it was expected that more severe forms of FGM would reduce the likelihood of premarital sex. The results concluded that FGM did not serve as a mechanism of postponing premarital sex and also there were no impacts on the marriageability of women. The fact that only a small minority of respondents believed that FGM reduced the risk of pre-marital sex and enhanced marriageability shows the traditional beliefs on FGM are eroding with time. The findings create questions on whether FGM effectively works as a means of sexual control and status indicator.

The bio-physical effects of female circumcision initiates high possibility for long term fertility issues for the women inflicted. It has been proposed that concerns about reduced fertility and infertility involving circumcision is widespread. Primary infertility or childlessness is measured as the proportion of married who do not have children after seven years (Larsen and Menken, 1989). Potential changes in fertility caused by FGM can have a substantial effect on population demographics of countries where there are high desires for children.

There are only few studies that have related aggregate fertility to female circumcision as most studies are carried out in clinical cases in the medical profession. In a study of Sudan, it was found that women with primary infertility had a significantly higher risk of having undergone the most extensive form of mutilation, although type of provider of was not concluded to have an effect on fertility (Almroth, 2005). Contrariwise, a study by Larsen and Yan (2000) revealed that there was no significant link between circumcision and fertility nor infertility in the Central African Republic, Cote d'Ivoire and Tanzania. In more specific terms, there was no change to the relative odds of having a child between circumcised and uncircumcised women. Surprisingly, the study revealed that circumcised women have higher TFRs and lower childlessness than uncircumcised women in Cote d'Ivoire and Tanzania. Reversed results were found for circumcised women in Central African Republic igniting some spurious result concerns. Health outcomes of women however were not studied which could perhaps effect a women's fertility. Findings from a WHO multi country study confirmed that circumcised

women had increased risk of adverse events in childbirth. Higher incidences of postpartum haemorrhage were found with regards to all types of circumcision (Khanna, 2006). Death rates during and immediately after birth higher to mothers who had undergone circumcision (Type I 15%, Type II 32%, Type III 55%) (Khanna, 2006). Regarding biological fertility, in Nigeria it was found that women with FGM were significantly more likely to experience reproductive tract infections (Shandall, 1967). Jackson et al (2005) found association between circumcision and longer birth spacing parities in Ghana, however this study was limited due to lack of severity data.

Besides biophysical effects of circumcision, another channel regarding regularity of intercourse can impact fertility. Regularity of intercourse can be affected by potential libido reductions caused by female genital mutilation. The conclusions on whether this is the case are not clear as detailed by Obermeyer (2005). Results of one study (el Defrawi et al, 2001) reports that circumcised women are have negative impacts on their psychosexual life. 250 women who were randomly selected from patients at a maternal and childhood centre were gynecologically examined and interviewed with results being increased vaginal dryness (48.5%), reduced sexual desire per week (28%), less initiative during sex (11%), complained of dysmenorrhea (80.5%) and reduced frequency of orgasm (25%). Another study that measure sexual activity and pleasure find no significant difference between circumcised and uncircumcised women (Morison et al. 2001, Okonofua et al. 2002), (Nwajei and Otiono, 2003). Additionally, it is found that sexual dysfunction exists in not only type III genital mutilation, but type I and II are also strongly correlated (Alsibiani, 2010). Johnsdottir and Essen (2004) investigate the sexual effects of female genital mutilation reporting that none of the immigrants in Sweden interviewed stated a loss of ability to have and enjoy sex. This has raised questions about the possible different views of pain and pleasure across cultures. They also suggested that immigrant's attitudes towards sex and circumcision are influenced by host country culture. For example, Ethiopian immigrants in Sweden held a more western view of circumcision. Polygamy is widespread in Senegal, a study of women in the Central African Republic suggested that coital frequency was decreased when the the woman in question was not the most recent wife in the polygamous marriage arrangement and those who had more surviving children (Stewart et al, 2002).

To this day, there are very few studies statistically linking fertility and FGM occurrence. Jones et Al (1999) found that women in Burkina Faso who were cut were more likely to experience obstetric complications. Additionally, an NHRC report concluded that circumcised women married earlier and had a higher total fertility than uncircumcised women (Reason, 2004). However, a Nigerian study found no relationship between FGM and fertility once social class and birth condition were taken into account (Slanger et al, 2002). The lack of quantity of studies that particularly look at marriage and fertility in regards to FGM warrant further investigation into the subject. Furthermore, economic

theories that are related to FGM have only merely been glanced upon and not tested. The economic theoretical framework regarding FGM are discussed in the next section of this paper.

## 6. Theoretical Framework

### 6.1 Principle Agent Model of FGM (Posner, 1994)

Posner (1994) makes use of the principle-agent framework (Ross, 1973) can be used as a theoretical framework in regards to FGM and the marriage market. This theory can be applied to this study by explaining the rational choices that occur when making decisions about circumcision. In addition, it is also a theory that represents the rational choice of wife selection through circumcision status. The principle agent theory suggests that there are perceived benefits to the husband and parents of circumcision which will influence agents to decide to circumcise their daughter.

The economic concept of agency costs is explained as fees that the principle is exposed to when choosing to hire an agent in acting on their behalf. The costs involved are vast but can be narrowed down into monitoring costs and risk level of the agent in keeping to the agreement. Agency costs arise due asymmetrical information which ensure that both parties have varying interests resulting in principles not being able to ensure that the agents act in their interest. Posner (1994) has used the idea to create an economic framework for FGM relating to polygamist marriage structures. By using the principle-agent framework it is suggested that FGM is a mechanism for lowering agency costs for husbands in a polygamist relationship as well as control over their daughters (Figure 2). The agency lowering mechanism of FGM hails from the interpretation that agents who are circumcised require less supervision from husbands. The reduction in supervision (monitoring costs) are due to the desexualisation associated with circumcision, supposedly reducing the risk of adultery in wives and ensuring virginity for daughters. This theory suggests that men who are in polygamous relationships will be more supportive of the FGM tradition.

Posner (1994: 257) regards FGM as “...*analogous to a medieval chastity belt, a measure for preventing the wife from committing adultery when...the husband would face insuperable costs of maintaining surveillance over her by normal methods.*”

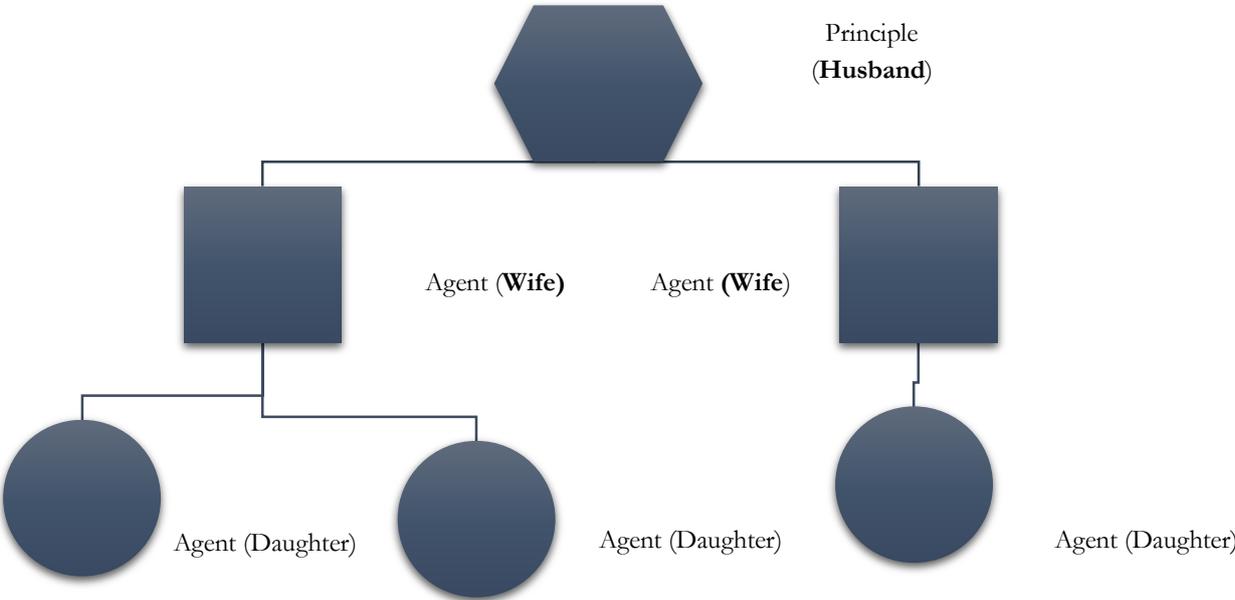
Men in polygamous relationships not only want to be able to monitor wives, but also daughters too. The decision to circumcise daughters will both be affected by the principle agency theory and the fact that their mother is circumcised. As discussed in the previous studies section, it is suggested that circumcision can bring higher value to girls on the future marriage market (by ensuring virginity),

creating higher dowry's and higher utility from marriage. The mothers circumcised status will also increase the chances of daughters being circumcised through tradition. Each family member may have different self - interests that deviate from that of the fathers (Summarized below).

- Self-Interests for Husband; Choosing circumcised wives and circumcising daughters;  
 Reduced adultery risk of wives higher later value on the marriage market for daughters.

The Principle agent theory will be tested in this study through a regression comparing individuals probability of circumcising their first daughter in both monogamous and polygamist marriage structures. Under the assumption that circumcision will raise the marriageability of daughters when monitoring costs are high in a polygamous marriage setting.

**Figure 2- Principle Agent of Circumcision:** *Due to the high number of agents to monitor in a polygamous relationship, the principle agent theory suggests the rational preference for the husband is to be a proponent of FGM.*



## 6.2 Identity Economics & FGM

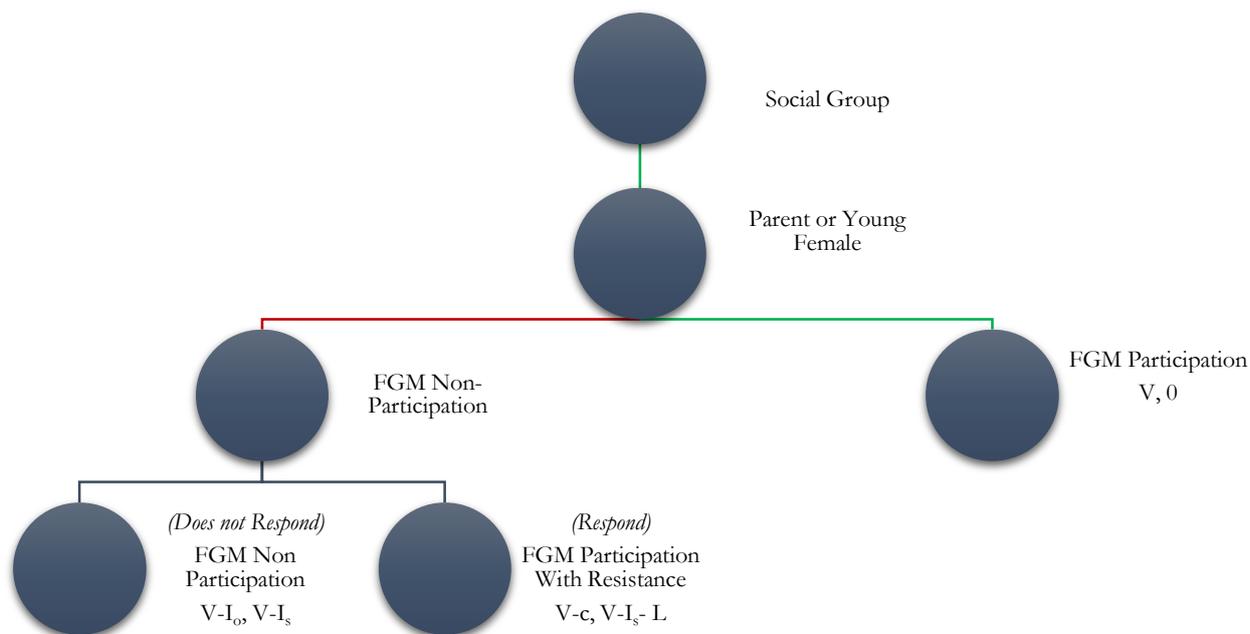
An alternative perspective using the concept of “Identity” can be employed as a mechanism to determine the causes the continuation of FGM practices. ‘Identity’ is a word that can be construed differently over disciplines, but in general relates to qualities and conceptions that make an individual or social group distinct from others. Mackie (1996) described FGM as a tradition and as a mechanism

to promote solidarity in a group and an important to signal the identity of a group from outsiders. Identity can strengthen the sense of community in a social group and also an impression of favouritism towards others who identify as the same social group. Coyne (2014) use identity economics (Akerlof & Kranton, 2000) to carve an individual utility function regarding circumcision decisions. The overall individual utility also depends on how well their own individual characteristics match that of their particular social group. Social group requirements can be a multitude of characteristics that associate with physical attributes and acceptable behaviour. In essence, high individual utility or quality of life is dependant on a strengthening identity that adheres to the social group. On the other hand, an individual that does not conform to the identity of the social group may be subject to ostracism and achieve a low level of utility. The role of group identity can provide an opportunity to relate rational economic decisions to FGM participation.

In this model, utility is dependent on circumcision decisions through a intergenerational perspective. For example, the circumcision of daughters can be associated with being a 'good' parent, causing utility of mothers to be related to the circumcision status of the daughter. As discussed before, circumcision can also result in higher parental utility due to better prospects in the future marriage market. FGM is seen as preparation for marriage and a better marriage match can possibly be attained through circumcision. In some societies where dowry is also traditional, a higher utility can also be attained through circumcision (Chesnokova et al, 2006). In the case of children, FGM may potentially be looked forward to as it represents the time where they will fulfil requirements of the social grouping increasing their own individual utility. The perceived costs involving the pain and long term effects of FGM in this case may or may not surpass the utility gains by adhering to social group traditions. It is assumed that FGM holds strong tradition in social groupings in Senegal. On the grounds that FGM has intergenerational utility consequences, ensures that all individuals have motives to continue the tradition. An individual who decides to deviate from this view may be harassed or socially excluded due to threats of breaking down the identity of the group. This threat of being extradited from the social group also plays a function in individual motives to be circumcised.

The identity theory will be tested in this study. The variable "relationship to household head" can be understood as differing levels of social pressures, ostracism and punishments that could potentially be inflicted upon the parent or young adult. The idea that costs of being FGM abhorrent can vary with closeness to the household head. Being the wife of the household-head for example may be subject to high costs of being FGM non-proponent. Furthermore, the first part of this study focussed upon socio-economic factors that could influence the payoffs associated with keeping the practice alive showing that the decision making process is uniquely individual.

**Figure 3 - FGM Identity Game Edited from Coyne (2014)**



**Key:**

**V**= Utility Payoff when young female or parents chooses her preferred activity

**-I<sub>o</sub>** = Utility Loss of the broader social group

**-I<sub>s</sub>** = Utility Loss of the individual (through ostracism or harassment)

**-c**= Social Group Utility Loss in replacement of restoring I<sub>o</sub>,

**-L**= Utility Loss of Young Female or Parents from being forced to take part in FGM.

In this identity game (Figure 3) assuming that all entities are initially thought to be a proponent of FGM, players will maximise their own utility when they choose an activity matching their own preference. For example, a parent who shares the belief of FGM continuation who actively chooses this route will maximise their utility. However, if the non preferred activity is not chosen then there will be losses to their utility in all cases. When FGM does not occur without the parent/ young female being a proponent, overall utility is loss through the identity of both the actor and the social group. The parents/young female will lose utility through ostracism by the social group and the social group will lose utility due to the real threat of their culture being diluted. If FGM participation goes ahead without being a proponent of the practise, there will be a loss to the parent's/ young female's identity (I<sub>s</sub>). There will a restoration of I<sub>s</sub> at a cost of C to the social group. In addition, there is a cost of (L) due to the punishment of the parents/ young female who resist the FGM tradition.

The identity game indicates the difficulty in stopping the FGM practise, as we see that there are incentives to keep circumcision running through families due to the intergenerational utility implications. Likewise, cultures of the social group are decisive in how losses in overall social utility are distributed, meaning that change of culture is likely the root in the abandonment of FGM. Culture is extremely hard to change and can take many years, especially when there are economic incentives in keeping traditions alive.

## 7. Hypothesis and Expectations

The first part of this study explores the presumption that the risk of circumcision varies over a number of socio-economic variables. This is shown through the choice of potential socio-economic variables that effect risk of FGM. It is expected that education, urbanisation, wealth, mother being circumcised, mother FGM proponent have a positive effect on the hazard of risk of circumcision of the first daughter. Likewise, it is expected that Muslim, Domestic Violence, and Polygamy will have negative relationships with the hazard of the risk of the first daughter being circumcised. Ethnicity implies that culture and tradition relating to each individual group will cause varying effects. Expectations of socio-economic factors are displayed in the data description tables.

This paper additionally, aims to test two economic theories of female circumcision. Firstly, the Principle Agent Theory suggests that respondent's in a polygamist marriage structure will be more likely to circumcise their daughters, as well as being circumcised themselves. This is due to men preferring for their daughters to be circumcised to reduce monitoring costs of women under their households. Men can also be under the assumption that non-circumcised women are promiscuous. In addition, circumcision can be channel to increase the value of a daughter on the marriage market, making it in the 3husbands best interest to enforce circumcision on his daughters.

**Hypothesis:** *The existence of a polygamist marriage structure will increase the odds ratios of the first daughter being circumcised.*

The second economic theory of circumcision is the Principle Agent Theory. The identity theory of FGM suggests that the decision of FGM is a cost vs benefit decision using game theory. This paper further suggests that based on individual circumstances, the costs and benefits of circumcision, can change through socio-economic and familial differences. The household head is likely one of the oldest in the familial network and therefore assumed to be FGM proponent. On the view that punishment for divergence from FGM tradition can be raised (raising costs) by increasing familial closeness of respondent to the household head, circumcision of the first daughter is also more likely.

**Hypothesis:** *The Likelihood of First Daughter Being Circumcised will increase as Respondent relationship to Household Head is Closer.*

The interlinked nature of female circumcision and marriage is rooted in cultural beliefs often pertaining to potential marriageability. There is also widespread confusion over the definitions of marriage in Western Africa and much of the criteria for marriage is loosely defined. Moreover, there are multiple kinds of marriage in Senegal, ranging from monogamy, polygamy and range of consensual union often based on financial gain. In particular, it is important to note that the definition of marriage can be understood discordantly to various individuals. An example shown by Pison (1993) cited that couples in seemingly identical situations may describe their relationship status in quite different ways and in some cases partners differ in view of their marital status. That being said, it is imperative to also view marriage in any African setting as more as a process rather than an event like that of a western society (Van der Walle, 1968). Marriage can take place over an extended period of time and it can therefore be necessary to locate the time span in which this first takes place. First co-habitation is linked to many different socio-economic and cultural factors, however FGM may play a role in indicating value on the marriage market. Traditionally, increased value may be experienced by women who are FGM inflicted. It is assumed the more traditional parts of Senegalese society are more probable to be FGM proponent where it is sometimes deemed as preparation for marriage.

**Hypothesis:** *FGM status leads to a decrease in the age of first cohabitation*

Fertility is measured through a measure of time between birth parity one and two. It is expected through previous research that the results could indicate negative effects on fertility through both physiological and behavioural impacts. Although it is difficult to ascertain which effect is stronger using this dataset, it could be construed that the physical effects of circumcision should relate to the women in their low parities. It is more likely that women will face negative effects on their fertility throughout their life. Behavioural effects are influenced by a range of socio economic factors and are also more likely to change through the life course as circumstances change. It is expected that Educational Attainment, Religion as well as Urbanisation will have strong effects on sexual behaviour. Behavioural differences between circumcised and non-circumcised women are likely to be shown in the spacing between parities if the procedure is associated with higher experiences of pain during birth. Women may therefore reduce their possibilities of childbearing through increasing the spacing between births.

**Hypothesis:** *Increasing severity of female circumcision reduces fertility*

## 8. Data & Methods

### 8.1.1 DHS Dataset

The Demographic Health Survey provides a wealth of data needed for this type of research data. DHS allows us to use important measures of economic, health and demographics that can be used for government intervention on a range of issues. In regards to FGM, the Senegal: Standard DHS 2010-2011 provides extensive data on socio-demographic, reproduction, marriage, sexual activity and FGM.

The original survey consists of 8232 households with the expectation that 15,044 women aged 15-49 will be interviewed. A primary sampling unit called a cluster was used where the census district (CD) or a section of the CD was used when the district was very large. Within each of the 391 clusters, 21 households were selected for the women's survey which is of interest in this study. The survey successfully interviewed 7,902 of the households with a response rate of 98 percent. 15,688 women were successfully interviewed with a response rate of 92.7 percent. The information that is in particular useful for this study is the collected data on parental histories that include the date of births of the respondent's children as well as the date of their first cohabitation. The units of measurement are in terms of days, months and years (dates) are known allowing for episodes of singleness and non parental status experienced by women in the survey. The original dataset was cleaned for the purpose of the study and the samples used can be seen in the descriptive statistics.

The Senegal DHS survey data set over represents some proportions of the population in Senegal. Weighting adjustment is used to even out any bias in the sample population using the weight variable included in the original dataset together with the cluster. Survey respondents who are under represented in the sample are given a weight larger than one. Correspondingly, survey respondents who are over represented are given a weight less than one. Reasons for why a weighting is needed is due to the self-selective nature of surveys, in which individuals willingly take part in the questionnaire. Another issue is non-response of certain groups of people which can cause over/under representation. Standard errors are also adjusted for clustering because error terms are commonly correlated for people living close together. Some biases may still be present however, due to unreliable information given by respondents. An example of this is shown through the age distribution in the data, where ages can be taken as "approximates" due to spikes in frequencies of specific ages (e.g. 15, 20, 25, 30). This suggests that many respondents are not sure of their actual age, and give an estimate.

## 8.1.2 Data Description: Socio-Economic Determinants of FGM

**Dependent Variable;** *First Daughter Circumcised;* Indicates whether the First daughter has experienced any kind of circumcision. Two outcomes are possible; Yes and No. The reason for focussing upon the first daughter is because it is most likely they parent will scrutinise the circumcision decision of their first daughter born. In addition, daughters born after the first daughter are most probably likely to follow the same fate.

**Independent Variables;** *Age of Respondent at First Birth, Educational Attainment Religion, Region, Ethnicity, Wealth Index; Respondent Circumcised, Respondent believes Circumcision should be stopped on continued (view of respondent), Circumcision required by religion (view of respondent), Respondent is Circumcised and marriage Structure. It must be noted that Religion, Ethnicity, Region and Urban/Rural are likely to be correlated.*

*Age of Respondent (Mother) at First Birth;* Age could play an important role in circumcision decisions and especially when regarding shifts in the importance of tradition over times generations as noticed by Almroth (2011). The age of first birth is a continuous variable recorded at the time of the interview.

*Educational Attainment;* Educational differences in populations can affect the way FGM is viewed and the perceived benefits and costs of the procedure. Women are separated into four categories describing whether they have no education compared to complete and incomplete primary and secondary educations.

*Religion;* FGM is common in both Christianity and Islam in Senegal and will greatly impact the decisions of circumcision. Categories in this variable are Islam, Christianity and Animist and No religion.

*Region;* This variable is used as a control and results are not displayed. The regional differences in FGM prevalence is not only due to ethnic group distribution. FGM incidence will be impacted upon regional differences due to deep historical, political, economic and colonial influence.

*Urban/Rural;* Those who live in rural areas are more likely to hold close to traditional values of circumcision. Rural states meet modernity with scepticism and view the movement as a threat to their tradition (Dellenborg ,2000).

*Ethnicity;* FGM culture and tradition will vary with different ethnic groups. This is shown by the the differences in the the age circumcision is usually carried out. In addition, each ethnic group will have shifting propensities towards FGM. Categories in this variable contain all the major ethnic groups (Wolof, Polar, Serer, Mandigue, Diola, Sonike, Non-Senegalese and Other.

*Wealth Index*; Wealth can influence FGM decisions due to the potential financial costs of the procedure and after care. Furthermore, higher wealth can be a sign of shifting cultural values affecting the strength of the FGM tradition. Wealth Index is a categorical variable separated into five quintiles from richest to poorest individuals.

*Domestic Violence*; Perceived attitudes towards what is acceptable reasoning for punishment could potentially influence parental decisions of daughter circumcision. A continuous index variable (1-20) was created from several variables related to whether women believed beatings were justified over a number of household events. A measure of domestic violence was created with the use of several variables that could potentially effect chances of violence. A simple summation methods was used to combine “justified beating” variables in the aim to create a single variable that would be robust to use as an independent variable. Answers that were given as “Don’t know” were recoded as 0.5 to represent between yes and no. A regression on the new “Domestic Violence” variable showed significance with other variables expected to be related. The logit regression made use of 6498 individuals matched the independent variables chosen.

*Respondent believes Circumcision should be stopped or continued*; Parental views will shift propensity to circumcise daughter. Respondents answered this question with four possible answers; Continued, Stopped, Depends and Don’t Know.

*Circumcision Required by Religion*; Confusion over whether circumcision is a religious prerequisite causes belief to differ on this issue. There are three possible categories ranging from Yes, No and Don’t Know.

*Respondent Circumcised*; If the respondent is circumcised, the possibility of passing down the tradition may be increased. Possible answers are Yes and No.

*Marriage Structure*; Preference for circumcised wives in a polygamous marriage structure may increase due to theories relating to minimising monitoring costs of wives. This categorical variable was created from questions asked whether their husband had any other wives. There are two types of Structure in this variable; Monogamous and Polygamous.

*Relationship to Household Head*; This variable is included due to the possible differential costs and benefits of FGM caused by circumstances of the wider social network. Differences in relationship to the household head could potentially result in varying pressure to continue the FGM tradition. A more distant connection to the household head may decrease the potential costs of familial ostracism and pressure through abstaining from FGM. The categories of familial closeness are Wife, Daughter, Sister, Grand-daughter and Other from closest to least close.

Table 1 shows descriptive statistics for variables used in the model for estimating Socio-Economic Determinants of FGM.

Table 1: *Descriptive Statistics for the full sample of the individual records from the Senegal DHS 2010-11 Data set, inclusive of Distributions, Means, Standard Deviation, Minimum and Maximum and expectation of results.*

Variable	Distribution	Mean	Std. Dev	Min	Max	Expectations
<b>Dependent Variable</b>						
First Daughter Circumcised		0.2	0.4	0	1	
<b>Independent Variables</b>						
<b>Educational Attainment</b>						- Higher Educational Attainment
<i>No Education</i>	62.2					
<i>Incomplete Primary</i>	16.6					
<i>Complete Primary</i>	3.4					
<b>Urban/Rural</b>				1	14	+ Increasingly Rural
<i>Urban</i>	39.5					
<i>Rural</i>	60.5					
<b>Religion</b>				1	96	+ Muslim
<i>Muslim</i>	95.4					
<i>Christian</i>	4.0					
<i>Animist</i>	0.6					
<b>Age at 1st Birth</b>		19.2	4.3	9	42	-
<b>Ethnicity</b>				1	996	
<i>Wolof</i>	31.5					
<i>Poular</i>	12.8					
<i>Serer</i>	6.6					
<i>Mandingue</i>	4.8					
<i>Diola</i>	2.3					
<i>Soninke</i>	2.0					
<i>Not a Senegalese</i>	7.2					
<i>Other</i>						
<b>Wealth Index</b>				1	5	- Higher Wealth
<i>Poorest</i>	23.7					
<i>Poorer</i>	22.8					
<i>Middle</i>	22.7					
<i>Richer</i>	17.4					
<i>Richest</i>	13.4					
<b>Domestic Violence</b>		3.8	3.2	0	20	+ Higher Domestic Violence Index
<b>Respondent Circumcised</b>						+ Yes
<i>No</i>	63.4					

<i>Yes</i>	36.6			
<b>FGM Respondent View: Stopped</b>				+ Yes

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<i>Continued</i>	23.4
<i>Stopped</i>	71.2
<i>Depends</i>	2.7
<i>Don't Know</i>	2.7

<b>FGM Respondent View: Required by Religion</b>				+ No
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<i>No</i>	69.9
<i>Yes</i>	22.8
<i>Don't Know</i>	7.4

<b>Marriage Structure</b>				+ Polygamy
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<i>Polygamous</i>	36.7
<i>Monogamous</i>	63.3

<b>Relationship to Household Head</b>	1	6	+ Closer to Household Head
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<i>Wife</i>	30.9
<i>Daughter</i>	21.6
<i>Sister</i>	4.0
<i>Granddaughter</i>	3.0
<i>Other</i>	39.4

### 8.1.3 Data Description: The Effects of FGM on Marriage & Fertility

The Senegal DHS provides data on the date of first co-habitation. As discussed in the expectations for this study, first cohabitation in a union can be understood as the entering of the women in question into the marriage process and will therefore be used as the dependant variable for study into marriage effects of FGM.

FGM can be viewed to have varying effects on fertility measures. It can be the belief that FGM can cause a reduction in the biological fertility of a woman causing her difficulty in conceiving due to genital trauma. A different view is that FGM will result in earlier marriages, resulting in an increased potential period of pregnancy (assuming low levels of pre-marital sex). It can be construed that there are low levels of premarital sex (at least disclosed) in the data set with average ages of sex and first-cohabitation being 17.47 and 17.84 years respectively. FGM may have contradictory effects marriage

and fertility. For example, FGM may cause a female's reproductive capacity to reduce but due to the fact of FGM causing early marriage, women may end up having more children over their life course. If these effects are true, it may be the case that one mechanism is stronger than the other and result in a cancelling out effect.

To find out how FGM can have an effect on fertility, we can test whether the extent of mutilation has a negative relationship with fertility levels. There are three types of circumcision detailed in the data set, which although so not follow WHO circumcision type definitions, provide an insight into the severity of mutilation. The proposed idea of this study being the greater the severity of mutilation, the larger negative effect on fertility levels.

**Dependent Variables;** *Date of First Co-habitation (For Marriage), Date of Second Birth (For Fertility); Time continuous variables indicating the exact date that respondents experienced the event*

### **Independent Variables**

Apart from female circumcision, the variation in marriage and birth intervals may be explained by other sociocultural and demographic factors. Controls on a number of socio-economic variables that can influence marriage and fertility decisions are put in place (Table 2). The variables are fixed (non-time variable) and maintain the same value throughout the observation period.

*Severity of Circumcision;* DHS data does not contain the information of type of circumcision performed to individuals, however they present variables relating to severity of the circumcision. Biological Impacts of FGM will be presented in the theoretical framework section. The DHS circumcision groupings are displayed below.

1. *Genitals are nicked without removing any flesh*
2. *Flesh removed from genital area*
3. *Genital area sewn closed*

*Religion;* Average marriage ages customs vary in both Christianity and Islam and have strong effects on marriage decisions.

*Urban/Rural;* Those who live in rural areas are more likely to hold close to traditional values of marriage.

*Educational Attainment*; Educational differences in populations will alter ideal marriage ages. Women in particular, gain increased opportunities in the labour market due to education. Additionally, education provides independence that can potentially delay marriage decisions.

*Wealth Index*; Wealth can influence marriage decision the financial costs of the event. Depending on who is the bearer of this financial cost, poorer women may be inclined to try and marry into a wealthy family. Wealth Index is a categorical variable separated into five quintiles from richest to poorest individuals.

*Ethnicity(Control)*; Marriage ages and customs will vary with different ethnic groups.

*Pregnant before Co-Hab (Control)*; Marriage decisions can be made on the basis of religion and cultural expectations of having children in wedlock. This binominal variable was created by comparing the variables “Age of first Co-Habitation” and “Age at first Birth” to determine those who had their first birth before marriage.

For measurement of fertility, the variable of contraception use is added as this has a powerful effect on control of fertility. In addition, a total of 27 women who had been sterilised are removed from the sample.

*Contraception Use*; Although contraception is not widely used in Senegal, there are both modern and tradition methods of conception prevention that is used and reduce fertility. Categories are Modern Method, Traditional Methods, Non User (intends to use later), Does not Intend to use.

The fertility Cox regressions must also take into account other demographic factors into account. It was decided to run regressions on a subset of the population that allowed for the most accurate result. It was necessary to take into account respondents preferences on their ideal number of children. The subsample used for the fertility Cox regressions only considered those who had an ideal number of children of two or more. This is to prevent individuals who would have different fertility behaviour from their before having their second birth. Births that were twins were also excluded from the regression.

The fertility Cox regressions controlled for Religion, Age at first sex, Age at first Co-habitation and Age at time of interview. Age at interview was vital to control for due to the decline in fertility associated with the onset of age. Other socio-economic variables were also considered to be used as control variables but these were found to create insignificant results, leading to a relatively simple regression specification.

Table 2: Descriptive Statistics for the variables used in the first Co-Hab and 2nd birth Cox-Proportional Hazard Model from individual records in the Senegal DHS2010-11 Data set, inclusive of Distributions, Minimum and Maximum, Mean and expectation of results.

Variable	Distribution % & Mean		Expectations
<b>Failure Variable</b>			- Shorter Duration + Longer Duration
<i>Date of First Cohabitation</i>			
<i>Date of Second Birth</i>			
<b>Dependent Variable</b>			
<i>Total Number of Children at age 40</i>	Mean: 5 Max: 17 Min: 0		
<b>Independent Variables</b>			
<i>Respondent Circumcised</i>	Yes: 36.5	No: 63.5	+ No
<i>Educational Attainment</i>	No Education : 58.0 Incomplete Primary : 17.9 Complete Primary : 3.8	Incomplete Secondary : 17.8 Complete Secondary : 1.0 Higher : 1.6	+ Higher Educational Attainment
<i>Rural/Urban</i>	Rural : 55.6	Urban : 44.4	+ Rural
<i>Religion</i>	Muslim : 94.6 Other : 0.56	Christian : 4.7	- Christian
<i>Wealth Index</i>	Poorest : 19.8 Poorer : 21.0 Middle: 23.5	Richer : 19.4 Rich : 16.4	+ Higher Wealth
<i>Contraception Use</i>	Modern: 8.7 Traditional : 0.7	Non-User- Intends to use later: 26.9 Does not Intend to use : 63.7	+ Modern
<i>Ideal Number of Children at age 40</i>	Mean: 52.6 Max: 20 Min: 0		
<i>Age of Husband at age 40</i>	Mean: 52.6 Max: 95 Min: 15		

## 8.2.1 Method: Multi-Variate Logit Model for Identifying Socio-Economic Risk Factors of FGM

The first research question will use a standard multi-nominal logit regression in order to link variables to the likelihood of FGM. The reasoning behind the use of the logit model is that the dependant variable is categorical. The logit regression estimates the probability of a daughter being circumcised in accordance to the attributes of the mother. These variables relating to the mother will be specified on the presumption that they will have impact on the likelihood of daughter FGM.

## Multi-Variate Logit Specification

$$\text{logit}C = \alpha + \beta_1 X_1 + \dots + \beta_k X_k + \varepsilon$$

In total, five models were created showing a progression of the specification by adding more variables. This method of starting with a simplistic model and then adding more variable in each subsequent model with allow for the interactions between variables to be appropriately analysed in the result section.

A complementary regression was created to test the Identity theory of FGM. A subsample of the full data set was used in this regression. A total of 4447 individuals were included in this regression who were FGM-Non Proponent. Individuals were included in this subset if they believed that FGM should be stopped in the 'FGM: Stopped or Continued' variable. On this assumption, all individuals should be naturally against the FGM tradition. The dependent variable in this regression is the same as the regression used for the Socio-Economic Determinant of FGM (First Daughter Circumcised). The outcome of this regression will calculate the odds ratios of parental decisions for circumcise their first daughter on the presumption that they are FGM non-proponent. The independent variable for this regression was Relationship to Household head and it assumes that The household head is FGM Proponent.

Additionally, a secondary complementary regression was conducted to test the Principle Agent Theory of FGM. The dependant variable was 'first daughter circumcised'. This time the FGM non-proponent subsample was not used and a total of 6,091 observations were recorded. The independent variable in these regressions is the 'marriage structure' variable used in the socio-economic determinants regression. The two categories in this variable are 'Monogamous' and 'Polygamous' The outcomes of these regression aim to show the odds ratios of how polygamist marriage structures can increase the odds of circumcision decisions of daughters. These results should clarify whether the Principle Agent theory of circumcision is relatable to Senegal.

## 8.2.2 Method: Application of Cox Proportional Hazard Regression Analysis for Marriage & Fertility

Hazard models are used to investigate factors that are associated with the occurrence and potential timing of events. The models have a wide breadth of use in the medical field but also is commonly applied to demographic issues such as the events of birth and marriage. Cox Proportional Hazard Regression Analysis is used to estimate the likelihood of an event occurring over the lifespan. In the case of this study, the events that are of interest is first cohabitation and the birth of a child and are defined as a binary indicator that informs when the subject in question experiences a change in state (e.g, marriage). The duration of the study is the period of time that there is a possibility of the event occurring. An episode of non event is defined as any period irrespective to length in which women have not had a child or never married. The duration of this study is defined as the age range where conception and first co-habitation will most likely occur (15-49). It is important to note that there are chances of events not occurring during the episode.

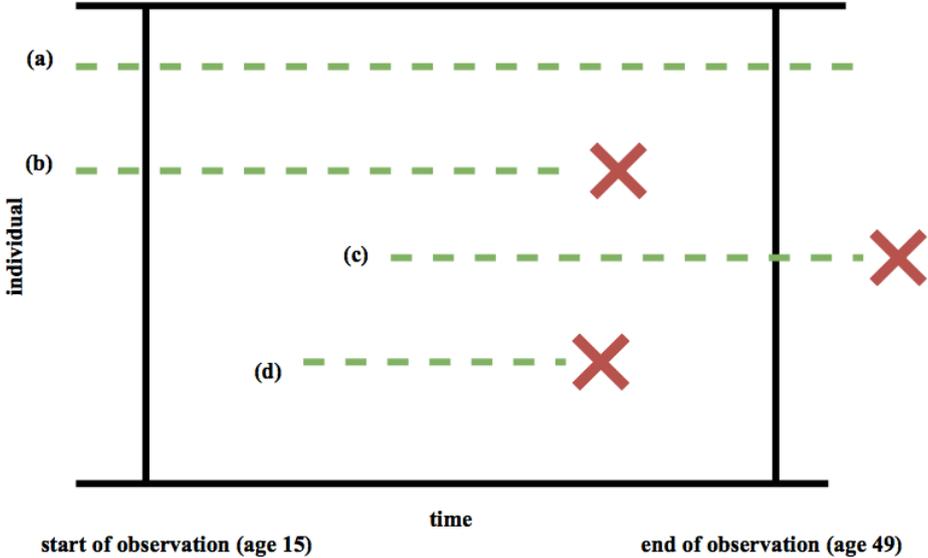
A single decrement model of proportional hazards will be used for the study of both first co-habitation and fertility to measure the risk of an event occurring over the prescribed time interval. When the event is experienced by an individual they are removed from the population at risk. This pertains to the fact that once a woman experiences her first-cohabitation event, it is irreversible in terms of state. This is identical to the Cox models used in measuring risks of shifting from alive to dead states.

Censoring is a situation where an individual has not yet experienced the event in question, but may do so in the future outside the observed episode (Figure 4). Left-truncated censoring involves the event being experienced before the observation period. In the case of marriage, this would occur as a case of child marriage. In the case of fertility, births are considered from the earliest considered fertile age (15 years). Appropriately, the dataset used contains data from women aged in the fertile period (15-49 years). More commonly, right-truncated censoring occurs when the event either never happens or is experienced after the period of observation. Reasons other than the event not occurring may be due to a lack of follow up in the data collection or refusal to participate in future questionnaires once having already committing to the initial questionnaire. In the event that individuals are excluded from the model due to their censored status, bias can occur and reduce the sample size. For the fully specified First Co-Hab Cox model, a subset was used of women aged 18-22 to ensure no violation of the proportional hazard assumption which will be duly explained. This subsample used created 6,917 subjects with 2,844 failures occurring over the 4-year episode. When full (15-49) sample of women was used, there were 14,226 subjects with 10,571 first co-habitation events “failures”. The use of the subsample is appropriate due to the fact that most first-cohabitations occurred in this age range.

Hazard rates are measures of the risk that an event occurs within the specified observation period. The individual is said to be in a state of ‘survival’ if they have not experienced the event yet. The calculation of hazard rates ensure that they are not biased due to changes in the population who have exited the study. For example, in a study of marriage, those who married or exited the study in the 1<sup>st</sup> year of the observation period are not included in the hazard rate for the subsequent years. Mathematically defined, the hazard rate of marriage in the second year is the number of marriage events divided by the number of individuals at risk during the second year of observation. The hazard methodology is defined as proportional to imply that hazard rates for the groups in comparison are constant over the observation period. A simple explanation of the proportional aspects of hazard ratios is seen when investigating the differential effects of males and females from the baseline hazard. Proportional hazard rates plotted over time will appear as complete parallel lines, if this does not happen, an appropriate specification allowing for this will be needed. In the analysis of fertility and first marriage, the event of becoming married or giving birth are referred to as ‘failures’. Each individual provides one spell that ends with the event occurrence or censoring. The event indication is binary and given as 1 = marriage/birth or 0 = censoring as there is no transitional state between the events occurring.

Fertility is specified and measured by analysing the time between the first and second births. Although many births can occur in a lifetime, this paper specifically looks at early parity spacing to determine whether fertility is affected by circumcision. The early parities are the most accurate in determining whether fertility is affected through circumcision due to women usually being in their prime fertile age range.

Figure 4: Graphical Presentation of Events and Censoring



## Cox Proportional Hazard Model Specification

The cox proportional hazard model specification follows the following design. This approach was reached as the most suitable due to its continuous time nature and allowing for a baseline hazard to remain unspecified in a semi-parametric model. An individual's baseline hazard of experiencing an event depends only upon time ( $t$ ). The baseline hazard is the hazard ratio with the absence of covariates. When covariates are added, they have a multiplicative effect on the hazard ratio. An increase of  $x$  by 1 will therefore be multiplied by the exponential of the  $\beta$ . A cox model is preferred in comparison to logistic specifications that ignore survival times and the presence of censoring.

$$h_i(t) = h_0(t)\exp(\beta x_i)$$

$h_i(t)$  = the hazard for the individual experiencing either a first marriage or birth.

$x_i$  = vector or co-variables that will be affected by  $\beta$  co-efficients

$h_0(t)$  = baseline hazard when  $x = 0$

The interpretation of odds ratios in the Cox Proportional Hazard models can be understood by the following.

$\exp(\beta) < 1$ : Negative effect (longer duration until second birth/marriage)

$\exp(\beta) = 1$ : No effect (no difference in duration until second birth/marriage)

$\exp(\beta) > 1$ : Positive effect (shorter duration until second birth/marriage)

### 8.2.3 Testing of Cox Proportional Hazards Assumption (PH)

Cox proportional hazard models contain the assumption that the hazard functions of two compared samples are proportional over time. Graphically this should be indicated by hazard functions that do not cross over time. A test is conducted after each Cox regression to give indications of whether the assumption has been violated. A variable that violates the assumption may not necessarily mean that the cox regression has no explanatory value, but instead the result can be understood as the average effect of circumcision status on fertility or age of first co-habitation. The Cox model used for first co-habitation initially violated the PH assumption, however after separating the age group to 18-22 therefore reducing the episode to 4 years, there was no violation occurring. Graphical and statistical testing of the Cox Hazard Models will be included in the appendix. A failure of the PH assumption does not necessarily mean that the result is not informative, but more that the result can be viewed as an average effect.

### 8.3 Method: Multi-Variate Poisson Regression

A Poisson regression will also be used in the analysis of fertility. This regression aims to measure total number of births over the lifespan, compared to the spacing between parities. The dependent variable of “Total Number of Births” allow for an estimation of whether circumcised women experience on average a reduced number of births as well as increased birth spacing. It may be the case that results of circumcised women’s spacing and total number of births could give surprising outcomes, due to birth intervals being longer whilst still recording a higher number of total birth. This could be potentially due to circumcised women first cohabitating at earlier ages as hypothesised earlier in this paper.

#### Poisson Total Fertility Specification

$$\mu = \text{texp}(\beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)$$

Where the Poisson incidence rate is denoted by  $\mu$  and determined by a set of  $k$  socio-economic regressors. The  $\beta$  estimates are unknown and are determined from the dataset, with the most important variable being circumcision status of the respondent. The Poisson regression will estimate the likelihood of births of circumcised and non-circumcised women.

The circumcision status of women will also be accompanied by a group of control variables. The model contains controls for Educational Attainment, Ethnicity, Wealth Index, Urban/Rural, Respondent, Age at First Birth. The control variables are selected from the same selection used for the Cox regression, but with several additions that are outlined next. This regression was limited to woman aged 40 to reduce the effects of culture changing over time.

*Age at First Sex, Age at First Co-Hab (Controls)*; Continuous Variables, detailing age at first intercourse, Co-Hab. On the presumption that women who start having sex earlier and marry earlier will be more likely to start their birth histories at an earlier age.

*Age at Husband (Controls)*; Continuous Variables, detailing age of husband at time of interview. Male fertility also declines with age and must be taken into account.

*Ideal Number of Children (Controls)*; Continuous Variable, detailing number of desired children. Controlling for this variable reduces the bias caused by natural psychological propensity for having children.

## 9. Results

### 9.1 Socio-Economic Determinants of FGM

Table 3 shows the Logit regression results relating odd ratios to first daughter circumcised. We can see clear gradients in the level of educational attainment and wealth in the chances of the first daughter being circumcised. Educational Attainment is significant, with regards to Incomplete Primary and Secondary categories in models 1-4. Results for Ethnicity are varied, Poular, Sonike and Non Senegalese are most likely to take part in circumcision. The Poular group (OR: 4.46) is the most strongly associated with circumcision of the first daughter, staying significant throughout all model specifications. Respondents living in Rural areas are also much likelier to circumcise their first daughter (OR:1.76) and is significant throughout model progressions. Compared to the Muslim majority, Christians and Animists are far less likely to circumcise their first daughter, although only Christianity is significant in the first three model specifications. The Domestic Violence variable created from variables used that would relate to women's rights and justified beating variables shows clear significance with circumcision decisions. On a scale from 1-20, an increase in one results in an increase in chances of circumcision of the first daughter (OR: 1.05). Respondent View on circumcision variables are predictably highly correlated with circumcision decisions. Respondent who believed that FGM should be stopped (OR: 0.2) were much less likely to circumcise their daughters compared to those who believed it should be continued. The same was seen for those who believed that circumcision was a requirement for religion (OR: 1.59). It was also shown that mothers who were circumcised results in a great rise in the chances of their daughter being circumcised (OR: 21.9), indicating the strong intergenerational effects of circumcision tradition. Age at 1<sup>st</sup> birth, showed increasing chances of daughters being circumcised, and although not significant in the models, we can assume that older women are more likely to be traditional in terms of their values on circumcision.

Table 3: Multi-Variate Logit regression examining socio-economic risk factors of FGM infliction on 1st daughter born with Odds Ratios

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Odds Ratio ST ERR				
<b>Educational Attainment</b> *None					
Incomplete Primary	0.48** (0.08)	0.52** (0.09)	0.55** (0.09)	0.70* (0.11)	0.73 (0.12)
Complete Primary	0.58 (0.17)	0.59 (0.18)	0.65 (0.20)	0.69 (0.25)	0.65 (0.24)
Incomplete Secondary	0.39** (0.13)	0.42** (0.13)	0.45* (0.14)	0.55 (0.20)	0.56 (0.23)
<b>Rural/Urban</b> *Urban					
Rural	1.57* (0.32)	1.76** (0.32)	1.73** (0.32)	1.68** (0.33)	1.76* (0.36)
<b>Religion</b> *Muslim					
Christian	0.17* (0.07)	0.18** (0.08)	0.19** (0.09)	0.39 (0.26)	0.30 (0.20)

Animist	0.32 (0.24)	0.39 (0.30)	0.40 (0.31)	0.62 (0.55)	0.61 (0.54)
<b>Age at 1st Birth</b>					
	0.98 (0.01)	1.00 (0.01)	1.00 (0.01)	0.99 (0.01)	0.99 (0.02)
<b>Ethnicity *Wolof</b>					
Poullar		42.28** (18.05)	41.05** (17.47)	4.54** (2.13)	4.46** (2.12)
Serer		7.04* (6.77)	6.92* (6.65)	4.57 (4.24)	4.66 (4.25)
Mandingue		26.53** (11.96)	26.11** (11.73)	2.03 (1.02)	2.09 (1.08)
Diola		20.54** (9.13)	20.49** (9.06)	1.91 (1.02)	2.01 (1.10)
Sonike		40.51** (22.64)	39.76** (22.43)	3.21 (2.00)	2.69 (1.75)
Not a Senegalese		30.57** (15.31)	29.37** (14.86)	2.96* (1.63)	2.96 (1.65)
Other		22.63** (11.48)	21.52** (10.74)	2.70* (1.36)	2.91* (1.50)
<b>Wealth Index *Poorest</b>					
Poorer		1.15 (0.15)	1.18 (0.16)	1.15 (0.17)	1.12 (0.16)
Middle		1.40 (0.24)	1.45* (0.26)	1.52* (0.27)	1.66** (0.29)
Richer		1.68 (0.46)	1.76* (0.48)	1.73* (0.48)	1.82* (0.52)
Richest		0.52 (0.22)	0.56 (0.23)	0.65 (0.25)	0.96 (0.40)
<b>Domestic Violence</b>			1.07** (0.02)	1.04* (0.02)	1.05* (0.02)
<b>Respondent Circumcised *No</b>					
Yes				23.79** (14.04)	21.90** (13.33)
<b>FGM : Respondent View *Stay</b>					
Stopped				0.23** (0.05)	0.20** (0.04)
Depends				0.33** (0.08)	0.36** (0.08)
Don't Know				0.25** (0.11)	0.18** (0.08)
<b>FGM : Respondent View *No</b>					
Yes: Required by Religion				1.70** (0.27)	1.59** (0.25)
Don't Know				0.95 (0.21)	0.96 (0.22)
<b>Marriage Structure *Monogamy</b>					
Polygamy					1.06 (0.13)
<b>Observations</b>	<b>6,498</b>	<b>6,498</b>	<b>6,498</b>	<b>6,498</b>	<b>6,047</b>
<b>Pseudo R2</b>	<b>33.31</b>	<b>39.03</b>	<b>39.38</b>	<b>51.6</b>	<b>52.01</b>

Significant : \* p<0.05; \*\* p<0.01 Controlled for, Region

Regarding the testing of the Principle Agent Theory, a simple logit regression was used to test whether women in a polygamous marriage structure were more likely to circumcise their daughters on the presumption that husbands try and reduce monitoring costs of women in their household through means of circumcision. This regression used a subsample of FGM Non-Proponent women, indicating they were not in support of FGM. A highly significant result was seen with women in a polygamous

marriage more likely to circumcise daughters (OR: 1.35) (Table 4). The Principle Agent hypothesis can therefore be proven to be correct showing that men potentially are more inclined to circumcise daughters when in polygamous marriage structures where there are many women under their control. Due to women who were Non FGM-Proponent being used as the sample, it is shown that circumcision still occurs even when parental views on circumcision may differ.

Table 4 : Logit regression examining Marriage Structure upon FGM infliction on 1st daughter born with Odds Ratios

Independent Variable	Model 1 Dependent Variable: <i>First Daughter Circumcised</i>
<b>Marriage Structure</b> *Monogamous	<b>Odds Ratio</b> ST ERR
Polygamous	1.35** (0.14)
<b>Observations</b>	<b>5774</b>

Significant: \* p<0.05; \*\* p<0.01

The testing of the Identity Theory of FGM is interesting as the results are varied (Table 5). There is a blurred gradient between relationship to household head and circumcision status. Under the assumption that Wife is the closest to the household head followed by Daughter, Sister, Grand-daughter and Other, we see that all categories apart from Sister show reductions in the chances of circumcision compared to the Wife. However, only the Grand-Daughter category (OR: 0.33) was significant. It is however necessary to understand the fall backs of this regression. Due to variations in generations that the categories belong, results are not reliable. Age is associated with tradition and culture and therefore likely to result differences in the propensity to circumcise over generations. We can apply this to the result for the Sister category (OR: 1.14), who may be more likely to belong to a similar age group as that as the Wife category used as a reference group. Additionally, this regression only relates the respondent’s relationship to household head. Circumcision decisions are likely to be taken by both parents, if not more by the male. It would be assumed that the identity theory hypothesis cannot be confirmed in this study.

Table 5: Logit regression examining respondent's relationship to household head upon FGM infliction on 1st daughter born with Odds Ratios

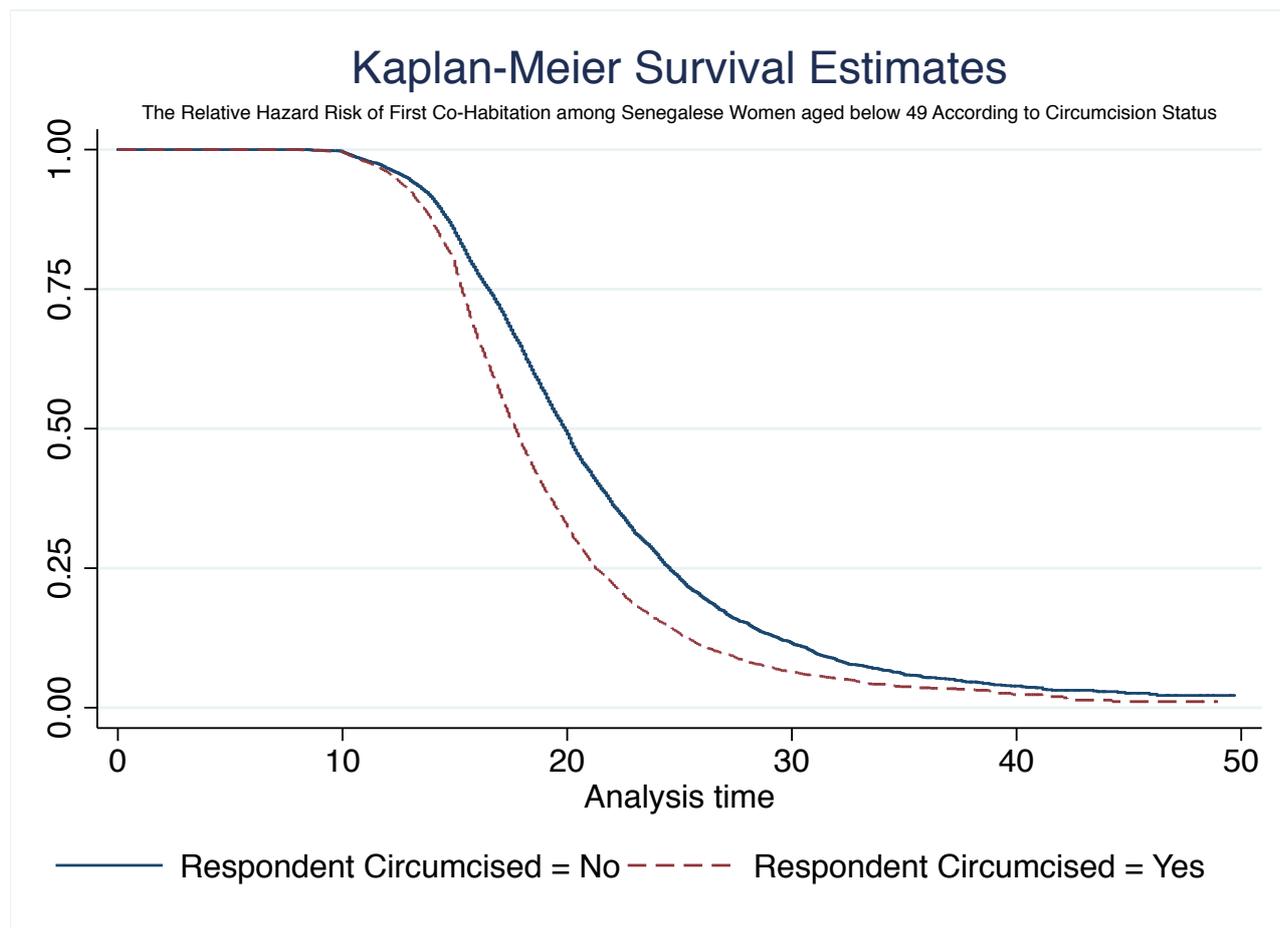
Relationship to Household Head * Wife	Model 1 Dependent Variable: <i>First Daughter Circumcised</i>
Daughter	0.74 (0.18)
Sister	1.14 (-0.26)
Grand-Daughter	0.33* (0.18)
Other	0.94 (-1.46)
Observations	<b>6193</b>

Significant: \*  $p < 0.05$ ; \*\*  $p < 0.01$   
Restricted to FGM Proponent Respondents

## 9.2 The Effects of FGM on the Age of First Co-Habitation

The analysis of marriage patterns was measured through age of first cohabitation due to the vague definitions of marriage in Africa where the event is more of a process than a single event. It was determined to use age of first-cohabitation as the measure of the initiation of this process. Progression from never cohabitated to first co-habitation used cox proportional hazard models to determine the timing of the onset of marriage. The Cox Proportional hazard model used women aged 18-22 to make sure the PH assumption was not violated. Even with this restrictive age range, the sample size consisted of 6917 subjects with 2844 of them progressing state from never cohabited to first co-habitation. The analysis time was measures in age from birth. The Kaplan Meier Survival estimate shows that there was evident child marriage with marriage beginning at ages at around ten years old. However, the estimates used in the cox regression model considered those aged 18-22 where the majority of first co-habitations took place. It is clear however that circumcised and non-circumcised women face different hazards of the risk of first co-habitation (See figure 5).

Figure 5: Graphical Survival Estimates for First-Cohabitation for Non Circumcised and Circumcised Women



The Results of the third specification Cox Proportional Hazard models (Table 6) show a clear correlation between circumcision status and timing to first-cohabitation. Circumcised women aged 18-22 experienced and a Hazard Ratio of 1.33 of first co-habitation compared to non circumcised women at the the simplest regression. Regarding the full specification, once Educational Attainment, Rural/Urban, whether the first pregnancy was out of wedlock, Wealth Index and Religion variables were taken into consideration the risk of first co-habitation reduced (HR: 1.18). Education levels were highly significant with respondents who had a higher education much less likely to enter a first cohabitation (HR: 0.11). There is a very clear gradient when looking at other educational categories. Even having a non complete primary education reduced the risk of first cohabitation substantially (HR: 0.84). Wealth levels have a great impact on risk of first-cohabitation with the richest respondents having a much reduces risk than the poorest (HR: 0.67). Christians also were less likely to cohabit earlier than Muslim respondents (HR: 0.73).

Table 6: Cox proportional hazard ratios comparing age of first cohabitation of circumcised and uncircumcised women among 6917 individuals measured from ages 18-22.

Independent Variable * denotes reference group	Model 1	Model 2	Model 3
	Hazard Ratio ST ERR	Hazard Ratio ST ERR	Hazard Ratio ST ERR
<b>Respondent Circumcised</b> *No			
Yes	1.33** (0.07)	1.29** (0.06)	1.18** (0.07)
<b>Educational Attainment</b> *None			
Incomplete Primary		0.80** (0.04)	0.84** (0.05)
Complete Primary		0.78* (0.08)	0.86 (0.09)
Incomplete Secondary		0.42** (0.03)	0.5** (0.03)
Complete Secondary		0.23** (0.06)	0.27** (0.07)
Higher		0.09** (0.04)	0.11** (0.04)
<b>Rural/Urban</b> *Urban			
Rural		1.39** (0.06)	1.28** (0.07)
<b>Religion</b> *Muslim			
Christian			0.73* (0.09)
<b>Wealth Index</b> *Poorest			
Poorer			0.93 (0.05)
Middle			0.75** (0.05)
Richer			0.79** (0.06)
Richest			0.67** (0.06)
<b>Number of Subjects</b>	<b>6917</b>	<b>6917</b>	<b>6,917</b>
<b>Number of Failures</b>	<b>2844</b>	<b>2844</b>	<b>2844</b>
<b>Time at Risk</b>	<b>18584.9</b>	<b>18584.9</b>	<b>18584.9</b>
<b>Log Likelihood</b>	<b>-24056.594</b>	<b>-23707.686</b>	<b>-23653.448</b>

Significant: \* p<0.05; \*\* p<0.01 Controlled for Ethnicity &Pregnancy before Co-Hab

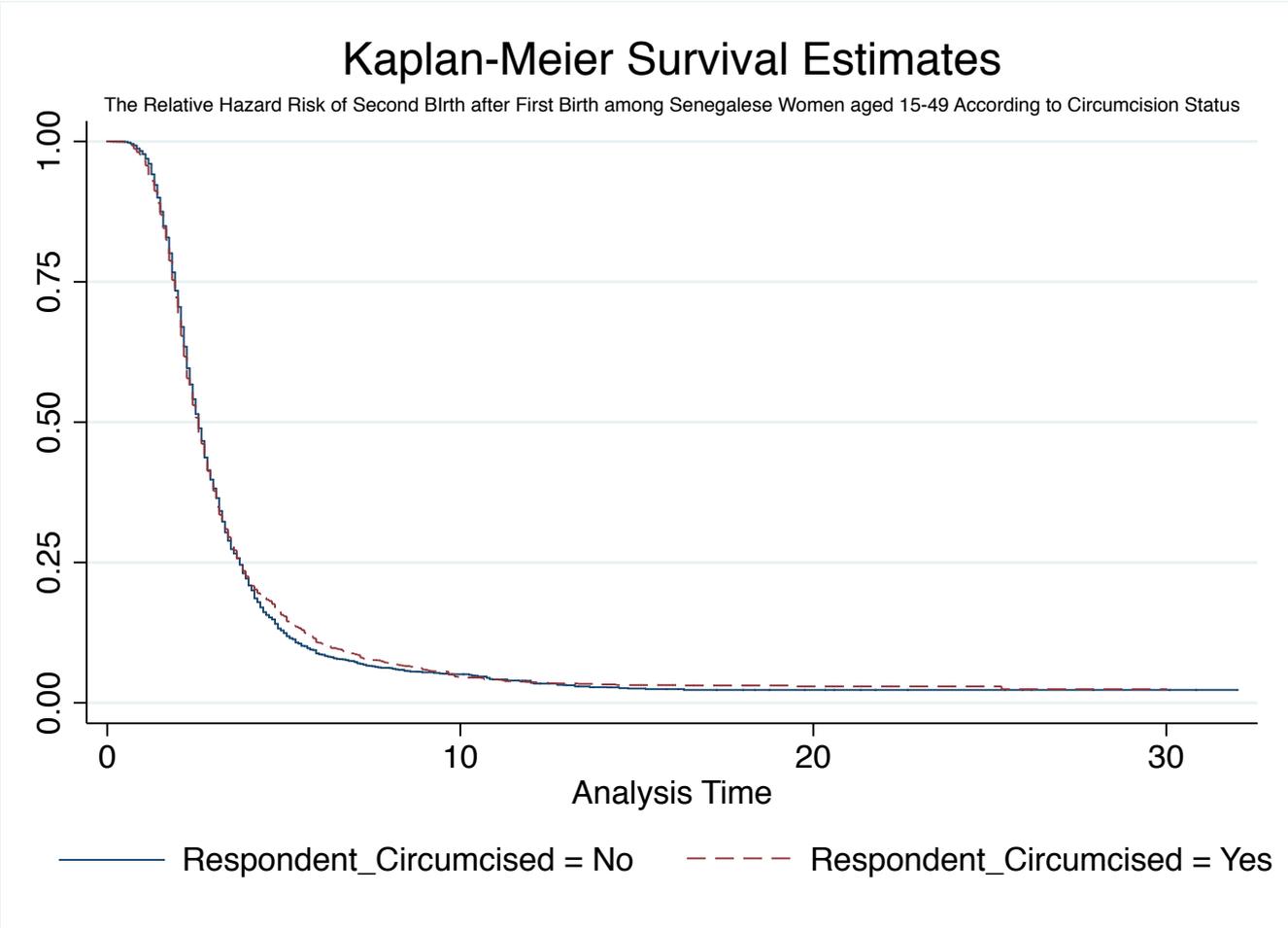
### 9.3 The Effects of FGM on the Spacing Between First and Second Birth Parities

FGM impacts on fertility was measured through the spacing between first and second birth parities. This was done through three specifications that differed with the first being whether the respondent was circumcised or not provide information on the average effect of all circumcised women in which ever form the procedure followed. The second specification provided women were cut with flesh removed compared to non-circumcised women as an independent variable. Finally, the third specification made of use of the most severe form of circumcision involving sewing on the vaginal opening compared to women who were not circumcised. All specifications were controlled for

Religion, Age at Interview, Age at first sex, Age at first Co-habitation and Twins. These regression models failed the PH assumption test and therefore must be seen as an average effect.

The Kaplan Meier Survival estimate (Figure 6) shows a small difference in the overall risk of circumcision on fertility.

Figure 6: Graphical Survival Estimates of second birth for Non Circumcised and Circumcised Women



Significant results were found on all three specifications for the Circumcision status variables (Table 7). The reason for which separate models were run for each severity category of circumcision was due to data circumstances. The dataset contained three categories (Nicked with No Flesh Removed, Flesh Removed, and Sewn), with the the least and middle severity having respondents having potentially answering yes to both severities. To avoid any confusion, only Flesh Removed and Sewn were used due to the total number of subjects who were circumcised (1,377) being the same as the number of subjects in the middle and highest severity categories. In the first specification, circumcised women were found to have an increase in spacing between first and second births (HR: 0.92). Interestingly severity of circumcision showed no correlation with birth spacing. Women who had flesh removed (HR: 0.91) and although not significant, those who were sewn (HR: 0.93) had similar spacing between

birth intervals. We can reject the hypothesis that increasing severity of female circumcision results in reduction in fertility levels.

Table 7: Cox proportional hazard ratios comparing timing of first and second birth parities of circumcised and uncircumcised women

<b>Independent Variable</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
	<b>Hazard Ratio</b>	<b>Hazard Ratio</b>	<b>Hazard Ratio</b>
	ST ERR	ST ERR	ST ERR
<b>Respondent Circumcised *Not Circumcised</b>			
Yes	0.92* (0.03)		
<b>Respondent Circumcised (Flesh Removed) *Not Circumcised</b>			
Yes		0.91* (0.04)	
<b>Respondent Circumcised (Sewn) *Not Circumcised</b>			
Yes			0.93 (0.07)
<b>Educational Attainment * None</b>			
Incomplete Primary	0.95 (0.05)	0.95 (0.05)	0.95 (0.05)
Complete Primary	0.95 (0.11)	0.95 (0.11)	0.95 (0.11)
Incomplete Secondary	0.92 (0.12)	0.91 (0.12)	0.93 (0.12)
Higher	0.31** (0.05)	0.31** (0.05)	0.31** (0.05)
<b>Wealth Index *Poorest</b>			
Poorer	0.95 (0.04)	0.95 (0.04)	0.95 (0.04)
Middle	0.87** (0.04)	0.87** (0.04)	0.87** (0.04)
Richer	0.79** (0.05)	0.8** (0.05)	0.8** (0.05)
Richest	0.68** (0.05)	0.69** (0.05)	0.69** (0.05)
<b>Contraceptive Use *Does not intend to use</b>			
Modern Method	1.49** (0.08)	1.5** (0.08)	1.49** (0.08)
Traditional Methods	1.15 (0.29)	1.14 (0.29)	1.14 (0.29)
Non User- may use later	1.12 ** (0.05)	1.12 ** (0.05)	1.12 ** (0.05)
<b>Number of Subjects</b>	<b>4471</b>	<b>4471</b>	<b>4471</b>
<b>Number of Failures</b>	<b>3907</b>	<b>3907</b>	<b>3907</b>
<b>Time at Risk</b>	<b>14061.97</b>	<b>14061.97</b>	<b>14061.97</b>

Significant : \* p<0.05; \*\* p<0.01 All models controlled for Religion, Age at Interview and Age at first sex, Age at first Co-Hab and Twins

Focussing upon other independent variables included in the specifications, results are as expected. Values of the odds ratios are more or less similar when regarding all three models. Higher education

saw a much increased spacing between first and second birth intervals (HR: 0.31). Increasing wealth was also seen to have a positive gradient with birth spacing. Significant results for Middle (HR: 0.87), Richer (HR: 0.8) and Richest (HR: 0.69) categories show a gradual increase in the spacing between first and second birth parities. The results of the fertility Cox regression model however failed the PH assumption that requires that the hazard ratio of circumcision status is constant over the analysis time. In essence, this means that the hazard level should be the same at all time points. There are many viewpoints existing upon the importance of the violation. For example, Alisson (1995) suggests that when a covariate fails the PH assumption the coefficient can be understood as an average effect of the treatment group. This viewpoint suggests that results should not be discounted just because of a PH assumption violation.

A Poisson regression (Table 8) was also conducted to determine total number of children born for circumcised and non-circumcised women. To take into account the effect of how variations in fertility decline and familial preferences, only women aged 40 were used in this regression. Limiting the number of subjects to those aged 40 allows us to look at women who have ended or are close to the end of their birth histories. It also allows us to limit variation in fertility behaviour caused by changes culture and attitudes over time. Due to the restriction in the age of women selected, the sample reduced to 638 individuals. The result was significant with circumcised women overall giving birth to 18.1 percent more children than non circumcised women. This suggests that although birth spacing appears to be longer for circumcised women, in the long run they give birth to more children over their life.

Table 8: Poisson regression examining circumcision status of respondent upon total number of children born

Independent Variable	Model 1
	Co-Efficient
	ST ERR
<b>Respondent Circumcised *Not Circumcised</b>	
Yes	0.1667*
	(0.79)
<b>Number of Observations</b>	<b>638</b>
<b>z</b>	<b>2.11</b>

All models controlled for Educational Attainment, Ethnicity, Wealth Index, , Urban/Rural, Age at First Birth, Age at First Co-Hab, Age at First Sex, Age of Husband, Ideal Number of Children, Contraception Use,

## 10. Discussion

The first part of this study explored socio-economic risk factors of the parental decision to circumcise their first daughter. Predictably, Education and Wealth, both had negative correlation with the risk of the first daughter being circumcised. Education provides a more informed decision on circumcision and the risk its poses reducing parents desire to pertain to the tradition not to mention can modernise respondent's outlooks on issues such as circumcision. Wealth is correlated to education and also reduced the propensity to circumcise daughters due to the less need for girls to be high value on the marriage market. As the Domestic Violence indicator rises, circumcision risk also rises. This can be explained by respondents being more content with lower women's rights as well as the overpowering husband decision in the circumcision process. Increasing Education levels and Wealth all drastically reduce the chance of first cohabitation. Likewise, as expected, living rural areas also speeds first cohabitation by 28 % in the fully specified model. Christians were less likely to marry earlier than Muslim women. Poular and Sonike ethnic groups posed highest risk of female circumcision. According to the data, Poular ethnicity had the highest proportion of individuals in the poorest category, where as Soninke were relatively rich suggesting that both differing wealth and traditional customs can alter risk factors of circumcision among ethnic group. Respondent views on circumcision, were predictable. It must be noted however that some of the variables included had a relatively small sample size for certain categories. Examples of this are Christians (183), Complete Secondary Education (21), Higher Education (50), Sonike Ethnicity (85) and Not a Senegalese (60).

The circumcision status of the mother is a defining factor in the decision making process of whether to circumcise the daughter. If the mother is circumcised it is 22 times more likely that daughters will be circumcised. This suggests that there is an intergenerational aspect to circumcision decisions. This is also shown through the Logit regression reviewing the identity theory of circumcision. It was shown that although a subsample of FGM Non-proponent respondents, that circumcision still occurs with polygamous marriage structures increasing this risk by 35 percent. There seems to be an obvious cost and benefit decision process of circumcision in this instance. Moreover, when testing relationship to household head with risk of first daughter being circumcised, we see a gradient with Sister, Daughter and Grand-Daughter. However, this regression did not take into account age, which is major factor due to the trends in FGM becoming less popular over time. It is more likely that older women (e.g., Wife and Sister) will stick to tradition circumcision culture compared to Daughters and Grand-Daughters. Results were also not significant bar, Granddaughter, suggesting that this test of the Identity theory should not be assumed as correct. It is important to remember there are a whole host of factors that may influence individual decision making, including outside influences that may not be recorded in the data.

This study has found that fertility and marriage patterns are indeed impacted through the FGM procedure. Circumcised women were seen to reach first-cohabitation at an accelerated rate compared to uncircumcised women. Specifically, it can be understood that circumcised women face an overall 18 percent quicker time to first co-habitation than those who are not circumcised when considering the full model specification.

Causation of the reduction in marriage ages is still unknown for circumcised women. However, the final specification used contains variables expected to be related to marriage which reduced the odds ratio for the circumcision status variable when added. Looking back at past studies and the anthropological background of FGM, we could assume that the purpose of FGM is to prepare for marriage. This would certainly provide some differences in the psychological outlook between circumcised and uncircumcised women. Women who were circumcised would be more inclined to marry as they feel prepared compared to uncircumcised women. This increase in the propensity to first cohabit is largely mental however socio economic characteristics of the women that will change their propensity to first-cohabit is largely behavioural. For example, wealth can be viewed in two contrasting manners. Women who have higher wealth could delay marriage, due to better opportunities for accessing education as well as making their marriage value allowing them to be more selective on the marriage market. Women with lower wealth may try to marry into a richer household quicker and therefore reduce their age of first-cohabitation. It must be said that marriage can be an expense and create barriers to the event occurring. Wealthier women are more likely to be able to afford marriage and therefore provides them greater accessibility to the opportunity of marriage. The former is more likely however given the marriage customs of Senegal, being that marriage is more of a process than a single event.

In the fertility regression, an attempt to separate differences in behavioural mechanisms was made. This was done by removing all women who had an ideal number of children as one and below. Including them would skew results slightly, even if this number of women was relatively small. Women who had an ideal number of children of one and below would behave differently in their fertility regimes and who most definitely try to cease potential conceptions or at least increase spacing. Removing these women from the sample aimed in taking out natural psychological differences between women. It is however necessary to take into account psychological differences that were caused by circumcision itself. The existence of circumcision could create higher pain when giving birth, reducing a women's propensity towards giving birth, that in turn will alter her behavioural towards spacing births. The results do suggest that circumcised women do in fact have larger birth spacing between first and second parities. Whether this is caused by bio-physical or psycho-

behavioural mechanism is still unknown. An attempt was made to ascertain how severity of circumcision impacted fertility, but the result showed little difference between fertility regime of women who had been subjected to the most severe form of circumcision (HR: 0.93) (sewn) and those who had a less severe form (HR: 0.91\*) (flesh removed). In any case, the differences between the broad group of circumcised or non circumcised and the severity variables are miniscule, indicating that negative fertility effects through bio-physical mechanisms of circumcision may be less than those of the psycho-behavioural.

It must be noted that differences in the behavioural and psychological mechanisms of marriage and fertility are hard to determine. This is due to some variables having effects that effect outcomes from both behavioural and psychological channels creating some confusion in the actual differences between behavioural, psychological and bio-physical effects of circumcision. The wealth variable can be related to many factors. Wealth could be a barrier towards access to good nutrition, which can therefore effect fertility and later life impacts. Pregnancy is associated with a higher nutritional demand for foetal requirements (Ebbs et al, 1942). The foetal origin hypothesis (Barker, 1997) suggests that later life health is determined in-utero and this can effect potential fertility. Gopalan (1972), talks of poor nutritional diet being a major cause of still births. Menken (1981) provides an important study into how nutrition level can effect fertility through study into the postpartum an ovulate which is the period of time where there is no ovulation after birth. Breast feeding is potentially an important variable in the length of the postpartum ovulate. In theory, nutritional status influenced by wealth can reduce the ability for a long postpartum ovulate and therefore minimise birth parity spacing. On the other hand, poor nutrition could limit the ability to conceive in the first place and increase birth parity spacing. It was decided however that breast feeding was not to be included in the model due to psychological differences as well as FGM exposure potentially having effects with the propensity to breastfeed.

The Poisson regression was used to explore the total fertility effect of circumcision on births over the birth history. The results showed that women who were circumcised, had a higher chance of having more children overall compared to their non-circumcised counterparts. Despite, the tendency for birth spacing to increase, the result from the Poisson regression suggest that women who are circumcised extend their child bearing ages to result in a higher total number of births. The results may seem contradictory, in the way that birth spacing increases while total number of children increases for circumcised women. However, it must be remembered that fertility is a conscious choice (Easterlin, 1975), women will aim to control their fertility so that their number of births best matches their ideal number of children. It seems that circumcised women have different psychological conscious when it comes to fertility preferences. The data does show that women who are circumcised also prefer more

children, whether the result of the Poisson regression is caused by the bio-physical effects of circumcision or psychological differences still remains unknown.

There are limitations to this study which are vital to summarize. This paper uses data collected from female respondents. The decision of circumcision, fertility and marriage are also likely to have a male influence. The DHS dataset used in this study, is mainly directed to wards female respondents. Education, Wealth, Ethnicity etc. of the respondents corresponding male influence is likely to affect the outcome variables. In any case, this study contains variables such as wealth, education level and domestic violence indexes which could represent a women's relative power in a relationship. Higher education and wealth combined with lower domestic violence indices (greater power) reduces chances of circumcision, marriage and births, indicating that these women have more control over these outcomes variables. The dataset seems biased in terms of age distributions. There were higher frequencies of respondents recorded as ages 20, 25 and 30 for example, suggesting that estimates of ages were given instead of real ages. This may be due to low education levels or the lack of a formal birth certificate. The definition of marriage is loosely defined in Africa. Marriage is more of a process than an event, leading Age of First Co-Habitation being used as an outcome variable to indicate the start of marriage. It is unknown however how long this process may take. Additionally, due to the grey definition, marriage can also be viewed differently by different respondents. For the study of fertility, full parities were not explored. Although this study takes the belief that the spacing between the first and second birth is the most important due to biological fertility being at its highest, circumcision could have hazard rates that vary as the parity becomes higher. Further studies could use cox models to calculate hazard ratios for all birth parities. The PH assumption for the fertility study failed, although in some ways the result can be used as an average effect, this could suggest that risk of a second birth varies with time. Efforts could be made to try and remedy this PH failure in future studies.

## **11. Conclusion**

This study has shown that FGM infliction is correlated with early marriage and also shorter birth intervals between first and second parities. Additionally, a range of socio economic characteristic also effect the risk of decisions regarding FGM on daughters. Delay in marriage ultimately contributes towards fertility reduction and due to FGM traditionally viewed as preparation for marriage it is important to direct policies towards the caseation of the practice. Reductions in fertility are important steps towards development, in which early marriage and birth spacing play significant roles. Results from this study are divisive. Although circumcision seems to lengthen birth spacing between first and second births, the Poisson regression suggests that circumcision results in higher total number of

children born. Circumcised women also were shown in a Cox Proportional Hazard Model to marry at earlier ages suggesting that early marriage due to circumcision overall increases total fertility even though the procedure causes an increase in birth spacing. Finally, it must be stated that the cause of changes in marriage and fertility due to circumcision is difficult to pin point. Circumcision does not only cause psycho-sexual and bio-physical alteration, but there are a host of socio-economic characteristics that FGM and Non-FGM inflicted women belong to which will inevitably effect conscious propensities to marry or have children.

Results of this study, add to the growing literature upon FGM, in particular in relation to future demographics. Relatively few studies look at severity of fertility, this study gives insight into the complex relationship between FGM and fertility. Further more, theoretical frameworks of circumcision have been rarely touched upon in previous studies. This study, offers support of the Principle Agent Theory, however results for the testing of identity economics of circumcision cannot be fully supported. This study offers avenues for further study into the use of FGM reduction in reaching development goals in countries where circumcision is widespread. Policies involved in stopping the practise could be used as an alternative to reach fertility reduction targets, and should be considered by governments may aim to reduce a youth dependency ratio.

## 13. Appendix

1: Cox Proportional Hazard Tests for Age of First Co-Habitation based on Schoenfeld Residuals

Global Test	Model 1	Model 2	Model 3
Chi-Squared	2.02	12.74	30.61
DF	1	8	23
P-value	0.155	0.121	0.133

2: Cox Proportional Hazard Tests for Onset of Second Birth Parity on Schoenfeld Residuals

Global Test	Model 1	Model 2	Model 3
Chi-Squared	135.77	151.57	133.23
DF	52	54	54
P-value	0.00	0.00	0.00

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