## Title

Investigating Pathways Linking Women's Status and Power to Skilled Birth Attendant Use at Childbirth in Senegal and Tanzania



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# Investigating Pathways Linking Women's Status and Power to Skilled Birth Attendant Use at Childbirth in Senegal and Tanzania

A dissertation submitted in partial satisfaction of the requirement

for the degree Doctor of Philosophy in Public Health

by

Kyoko Shimamoto

2015

ABSTRACT OF THE DISSERTATION

Investigating Pathways Linking Women's Status and Power to
Skilled Birth Attendant Use at Childbirth in Senegal and Tanzania

by

Kyoko Shimamoto
Doctor of Philosophy in Public Health
University of California, Los Angeles, 2015
Professor Jessica D. Gipson, Chair

***Background***

Maternal mortality remains unacceptably high in lower- and middle-income countries, with 289,000 women dying every year due to causes related to pregnancy and childbirth. Although the vast majority of deaths are preventable, progress in reducing maternal deaths has stagnated, especially in sub-Saharan Africa. The use of a Skilled Birth Attendant (SBA) at childbirth has been identified as a key intervention to prevent maternal deaths, yet SBA use continues to be limited in Africa.

***Method***

This study examined the mechanisms and complex pathways linking women's status and power to SBA use in the two distinct African countries – Senegal and Tanzania. This study used the Demographic and Health Survey Datasets in 2010, and conducted regression analysis, mediation analysis, and structural equation modeling. The study sample included all births occurred in the last five years (weighted n=10,688 in SN; 6,748 in TZ) to currently married women (weighted n=7,033 in SN; 4,445 in TZ). Women's education is examined as a proxy of women's status. The structure and multiple dimensions of power were identified in both countries as: age at first marriage, household decision-making power, perceptions of gender norms against violence, and perceptions for sex negotiation.

***Results***

Overall, there is a significant relationship of SBA use with women's status and power, yet the results demonstrated the disparate influences of women's education on SBA use – directly and indirectly in Tanzania, and indirectly in Senegal. Multiple dimensions of power influence SBA use as a direct and mediating determinant. However, the significant dimensions differ by country: decision-making in Tanzania; perceptions of gender norms against violence and for sex negotiation and age at first marriage in Senegal. The influence of

sociodemographic characteristics (e.g., employment, household wealth) also showed variations across settings.

***Discussion***

This study provides valuable insights in to the potential causal pathways and mechanisms by which women's status and power influence SBA use. Moreover, this study confirms the importance of identifying and using analytic techniques to appropriately model the multidimensional and contextual nature of women's status and power. The results highlighted the need for culturally and contextually tailored policy and program interventions to support advancements in gender equity and women's empowerment, as a means of improving maternal health in Africa.

The dissertation of Kyoko Shimamoto is approved.

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2015

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## AWARDS AND HONORS

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# Chapter 1. Background

## 1.1. Introduction

Maternal mortality remains unacceptably high in low- and middle-income countries, with 289,000 women dying every year due to causes related to pregnancy and childbirth (WHO, 2014). Although the vast majority of deaths are preventable, progress in reducing maternal deaths has stagnated, especially in sub-Saharan Africa. The use of a Skilled Birth Attendant (SBA) at childbirth has been identified as a key intervention to prevent maternal deaths, yet SBA use continues to be limited in Africa. Using regression analysis, mediation analysis, and structural equation modeling, this dissertation analysis examines the potential causal pathways and linkages between women's status, women's power, and SBA use in Senegal and Tanzania. Given the heterogeneity of African countries, investigation of determinants and mechanisms in different country settings is important. In this dissertation, I investigate the use of SBAs in two countries in different regions of Africa: Senegal in the Sahelian Region of West Africa and Tanzania in the southern part of East Africa. The two countries were chosen because they have similarities in some health indicators, but are culturally and economically distinct, with varied colonial and post-colonial political histories, roles of women in society, religious orientations, and health systems. Thus, Tanzania and

Senegal provide two contrasting case studies for investigation of the mechanisms in which women's status and power influence SBA use.

## 1.2. Background

### 1.2.1. Definitions and Epidemiologic Trends of Maternal Mortality

The most widely-used definition of maternal mortality or "*Maternal death*" is "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, except from accidental or incidental causes" (WHO, 2014). Maternal deaths are classified by cause: "*direct obstetric death* - death resulting from obstetric complications of the pregnant state (i.e., pregnancy, labour and the puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of them"; and "*indirect obstetric death* - death resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but was aggravated by physiologic effects of pregnancy" (WHO, 2014).

The reduction of maternal deaths has been on the global health agenda for decades, and has included such efforts as the Safe Motherhood Initiative in 1987 and the International Conference on Population and Development (ICPD) agenda in 1994, which highlighted the

role of reproductive health in improving the health and well-being of women, children, and communities. However, reductions in maternal mortality have been far less than expected due to historical neglect of the issue and inadequate political and financial commitments (Shiffman&Smith, 2007). For the first time, in 2000, the improvement of maternal health was included as a part of the broader development agenda when the United Nations identified Millennium Development Goal (MDG) 5 – to reduce the Maternal Mortality Ratio (MMR) by three quarters (i.e., 75% reduction) between 1990 and 2015.

Although reductions in maternal mortality have been achieved in some regions of the world, maternal mortality remains disproportionately and unacceptably high in some developing regions, especially in sub-Saharan Africa (SSA). The estimated MMR in SSA was 510 per 100,000 births in 2010, which is calculated based on the number of maternal deaths during a given time period per 100,000 live births during the same time-period. This ratio is much higher than the global average of 210 per 100,000 (WHO, 2014). More strikingly, the lifetime risk of maternal death – the probability of dying from a maternal cause during a woman's reproductive lifespan – was 1 in 38 in SSA, while the world average was 1 in 190 (WHO, 2014). This disparity has been cited as the "largest discrepancy of all public health statistics" and is far greater than the disparities between more developed and lesser developed settings in child or neonatal mortality (Ronsmans et al., 2006). The continuing trend of high fertility in SSA also negatively affects maternal health (Shiffman, 2000), as it

results in an increased number of pregnancies and deliveries and thereby increases the probability of negative delivery outcomes.

Progress in reducing maternal mortality has mostly stagnated in sub-Saharan Africa (SSA), despite the global target of MMR reduction by three quarters (75%) from 1990 to 2015 (UN, 2014). While cross-national studies indicate some commonalities across countries in maternal mortality trends, substantial variations are also observed across countries and regions. These variations have been attributed to a variety of clinical aspects of pregnancy and delivery, health systems and facilities, and sociocultural factors to be described more in the following section.

### 1.2.2. Characteristics of and Risk Factors for Maternal Mortality

Maternal deaths are more likely to occur between the third trimester (after 28 weeks of gestation) and the first week after the end of pregnancy. Mortality rates can be also high after unsafe abortion or stillbirth. Maternal deaths have been mostly reported to take place in health facilities, due to the fact that these deaths are more likely to be reported than deaths that occur in the community (Graham et al., 2008).

Major direct causes of maternal deaths include severe bleeding, high blood pressure during pregnancy (pre-eclampsia and eclampsia), and infections (WHO, 2014). The large proportion of maternal deaths occurring within a health facility has raised concerns regarding

the accessibility of care (e.g., distance, transportation, cost, and referral systems), availability of quality obstetric care (e.g., delays and substandard practices, and sheer absence of human resource and facilities), and other barriers that may be created or exacerbated by the sociodemographic characteristics of women and their households (e.g., household wealth and education). These concerns are reflected in the scientific evidence, wherein inequities in maternal health service seeking and outcomes are widening, rather than narrowing, in low- and middle-income counties (Ronsmans et al., 2006).

The risk of maternal death in sub-Saharan Africa (SSA) varies according to the sociodemographic characteristics of women and households. For example, low-income women living in rural areas are generally found to be the most vulnerable. Maternal deaths are more prevalent in rural than urban areas due, at least in part, to differences in physical access to health services; household wealth is positively associated with maternal survival, possibly explained by economic capacity for accessing and using health services (Ronsmans et al., 2006). Other identified risk factors for maternal mortality include low education and social standing, young age, and high parity, whereas marital status and ethnicity show varied associations with maternal deaths (Ronsmans et al., 2006). It should be noted, however, that there is limited evidence from SSA, which is comprised of findings from select countries. Thus, the generalizability of these findings can be questionable across SSA, which is

comprised of diverse sub-regions and countries with distinct sociocultural contexts that may differentially influence the likelihood of maternal death.

Pregnancy at early ages is another critical risk factor for maternal death. The MMR for those aged 15-19 are twice that of women age 20 and older (WHO, 2011). The risk is explained by the immature reproductive and immune systems of adolescent girls, as well as sociocultural contexts that prevent girls from accessing reproductive health services (Bearinger et al., 2007). Barriers in seeking reproductive health services among adolescents include restrictive laws and policies hindering their access to services, social and cultural norms that denounce premarital sex and contraceptive use, inequity and substandard services that are unfriendly to adolescents, and inadequate economic capacity to pay for services (Bearinger et al., 2007). Moreover, early childbearing often leads to high parity and, consequently, to the higher probability of maternal mortality or morbidity (WHO, 2011), by increasing the number of pregnancies and inhibiting prompt recovery after pregnancy and delivery.

In Africa, the risks of pregnancy among adolescents are particularly pronounced. It is estimated that over a million births may occur to girls age 12-15 in Africa each year, and the percentage of girls giving birth at age 15 or younger can be over 10% in some countries (Neal et al., 2012). In Africa, 25% of all unsafe abortions are among adolescents aged 15-19 (Wellings et al., 2006). A cross national study of 25 sub-Saharan countries using

Demographic and Health Survey (DHS) data shows that adolescents age 15-19 are less likely to use Skilled Birth Attendants at childbirth than women age 20 and older (Magadi et al., 2007).

Early marriage has been identified as a strong predictor and proximate determinant for early childbearing (Bongaarts, 1978, 1982). In low- and middle-income countries, nearly one in every four adolescent girls age 15-19 is married or in union (UNICEF, 2012), and almost all adolescent births (90%) occur within marriage (WHO, 2008). Even if existing laws prohibit early marriage below age 18, data shows that the implementation is weak globally (UN, 2011). Negative consequences of early marriage are considerable especially for girls. Their educational and social opportunities (e.g., schooling, social and support network) are often deprived, constraining girl's knowledge, skills and human development (Lee-Rife, 2012; UNICEF, 2012). As a consequence of early marriage, pregnancy and childbearing at early ages lead to the elevated risk of delivery without a skilled professional, as well as higher risk for maternal and child death (WHO, 2011). Child brides are also at greater risk of domestic violence and HIV infection (Lee-Rife, 2012; UNICEF, 2012). Thus, early marriage is likely to be indicative of the low level of women's power, and negatively related to several forms of power.

### 1.2.3. Skilled Birth Attendant (SBA) Use and Determinants

In the following sections, I will synthesize the evidence on trends and determinants of maternal mortality from studies that examine 'delivery care use' - the use of a Skilled Birth Attendant (SBA) and/or attendance at a health care facility. Although most health care facility deliveries are attended by SBAs, not all are. Conversely, SBAs may attend home births. Thus, as there is considerable overlap in the characteristics and determinants of these two outcomes, I will present the data from studies that examine one and/or both of these outcomes primarily in sub-Saharan Africa.

***Definition and Trend of SBA use***

Evidence indicates that survival for mothers and newborns improves with professional care at childbirth, such as that provided by a Skilled Birth Attendant (SBA). An SBA is defined as someone "trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the identification, management and referral of complications in women and newborns" (WHO, 2004). SBAs also provide Emergency Obstetric Care (EmOC), defined as "ensuring the availability, accessibility, quality, and use of services for the treatment of complications that arise during pregnancy and childbirth" (WHO, 2009). Use of SBA at childbirth is recognized as the most effective contemporary

programmatic approach to addressing maternal death, because of its potential to avert 16 to 33 percent of maternal deaths (WHO, 2004; Graham et al., 2001).

Over the past twenty-five years, the proportion of births attended by SBAs has gradually increased globally. A cross-national study of 64 countries shows a positive relationship between the proportion of SBA use at the country level and the national MMR (Shiffman, 2000). However, in sub-Saharan Africa (SSA), only half of deliveries are attended by SBAs (UN, 2014), an indicator that has showed little progress between 1990 and 2012, from 40% to 53% (UN, 2014). In particular, rural SSA showed no improvement in the proportion of births attended by SBAs and continues to be plagued by inadequate access to emergency obstetric care (e.g., availability of surgical services for emergency cesarean section) (WHO, 2009). Persistent barriers hinder the use of delivery care services even if they are available, due to women's preferences for delivering at home – preferences that are strongly shaped by sociocultural norms (e.g., female birth assistances) and the quality of care in health care facilities (Thaddeus&Maine, 1994; Koblinsky et al., 2006).

***Determinants of Delivery Care Use***

The barriers of delivery care use include: low economic status of women and households which hinders women from accessing and using health care, low education as indicative of women's lower social status, physical distance to facilities, and lack of

transportation (Koblinsky et al., 2006; Thaddeus&Maine, 1994). Additionally, women's limited power in deciding the type of care and provider inhibits delivery care use, as well as other reproductive health service use and behaviors (Koblinsky et al., 2006; Thaddeus&Maine, 1994; Malhotra et al., 2002). Women and their families may have also difficulties in detecting and acting on complications that require medical support, and these difficulties can cause delays in decision-making and hinder delivery care seeking (Thaddeus&Maine, 1994).

These constraints are also often accompanied by shortages of skilled professionals and health facilities. At health facilities, many women deliver with the help of attendants, yet these attendants are often not well-trained and may not provide competent care. Deliveries are often assisted by non-skilled health staff (e.g., MCH aides) at health facilities, even if skilled professionals are available. Poor quality of care provided by health professionals and/or perceived by clients can also prevent women from seeking delivery care, even where the service is available and accessible (Thaddeus&Maine, 1994). However, even in the case of deliveries attended by SBAs, there is some evidence to indicate that these deliveries are not always associated with better delivery outcomes (Harvey et al., 2007).

In this way, a complex set of factors affect delivery care use at the facility, as well as the individual, household, and community levels. Overall, the body of literature highlights the influence of sociocultural factors on delivery care use at multiple levels. Particularly,

women's status and power have been identified as one of the key determinants of delivery care use in Africa and other low-resource settings (Koblinsky et al., 2006; Thaddeus&Maine, 1994).

### 1.2.4. Define and Operationalize Women's Status, Power, and Empowerment

Women's status, power, and empowerment are terms that have been commonly used in the literature to describe the social position of women and their ability to make decisions and take action on issues affecting their well-being (Malhotra et al., 2002; Kabeer, 2001; Safilios-Rothchild, 1982). *Women's status* is defined as "women's overall position in the society" (Safilios-Rothchild, 1982), which encompasses their educational, cultural, economic, legal, and political position in a given society (Thaddeus&Maine, 1994). In studies in SSA, women's status is mostly operationalized in terms of women's socioeconomic status, specifically women's education, with some studies also examining women's education relative to her partner/husband, women's employment and household wealth. The concept of women's status is often related to the concept of women's power and/or empowerment as a process; however, they have different definitions.

*Women's power* is differentiated from women's status, and is defined as "women's ability to control or change other women's and men's behaviors and the ability to determine important events in their lives, even when men and older women are opposed to them"

(Safilios-Rothchild, 1982). *Women's empowerment* is also differentiated from women's status and power and has been defined by Kabeer (2001) as the *process* by which those who have been denied the ability to make strategic life choices acquire such ability. The ability to exercise choice incorporates three inter-related components – resources (as pre-conditions), agency (as process), and achievements (as outcomes) (Kabeer, 2001). "Resources" include material, economic, human, and social resources that enhance the ability to exercise choice, and these resources are determined by the norms and practices in a given context. "Agency" is the ability to define one's goal and to act upon these goals in a wide range of purposive actions (e.g., decision-making, bargaining, negotiation, deception, manipulation, subversion, resistance, and protest). "Achievements" are generally recognized as outcomes of exercising these abilities (Kabeer, 2001). Therefore, "resources" and "agency" are the two most common components of empowerment that are emphasized and examined in the literature. These components, however, encompass several domains including economic, socio-cultural, familial/interpersonal, legal, political, and psychological aspects of women's lives (Malhotra et al., 2002).

Scholars also discuss other terminologies, for example women's autonomy, bargaining power, and gender equality. While these terminologies can contain similar aspects, they also have distinct implications in reference to the term "power" and/or "empowerment". For example, the concept of women's autonomy is mostly associated with

women's independent functioning and decision-making, whereas empowerment may well be achieved through interdependence with supportive others in her life (e.g., partner, family, etc.) (Malhotra et al., 2002).

An important aspect to consider in the review of the women's "empowerment" literature is that while the term "empowerment" is conceptualized as a process, the vast majority of studies in this area rely on cross-sectional data collected from one point in time. Thus, while references to the existing literature will often discuss women's "empowerment" as the outcome or variables of interest, some could argue that these studies actually attempt to approximate women's "power", rather than "empowerment". While I acknowledge this distinction, in the following critical review I will maintain the original terms used by the authors.

Literature reviews found that scholars examined women's empowerment mostly through women's participation in decision-making on household matters, and either access to, or control over resources (e.g., household income) that represent "agency" and "resources" (Kabeer, 2001; Malhotra et al., 2002; Upadhyay et al., 2014). Examples of most frequently used domestic decision-making measures include financial and resource allocation and expenditures; child-related issues (e.g., schooling, and health); and general domestic matters (e.g., cooking). These decision-making questions are mostly operationalized to assess if women participated in decisions (i.e., alone, jointly with their husband/partner/family) or

not (i.e., no participation) (Malhotra et al., 2002). This operationalization aligns with the understanding of empowerment that can be achieved through interdependence, which is differentiated from the term "autonomy" focusing on independence.

Perceived gender norms are also examined, which mostly focus on relationships of women with their partners and perceived equity in power and resources in households, as influential factors for "resources". Examples of these measures include norms against gender violence; norms regarding sexual negotiation (e.g., acceptance for sex negotiation and condom use); patriarchal norms (e.g., son preference); and norms regarding women's freedom of movement (Malhotra et al., 2002). Progressive gender norms that support greater equity between men and women are indicative of greater empowerment.

Early marriage and childbearing are also considered to be indicators of women's status, power, and/or empowerment in some settings. Marriage and childbirth are major life events for women, yet the extent to which these events are considered to be true "choices" has been contested (Lee-Rife et al., 2012; UN, 1995). Both the Convention of the Rights of the Child (1989) and the African charter (1981) prohibit marriage before age 18 as individuals are still considered to be children at this age. Thus, early marriage generally refers to marriage below age 18. However, most of the countries, including those in Africa, allow marriage of girls under age 18 with parental consent (UN, 2011).

### 1.2.5. Findings and Methodologies from the Literature

Several national-level empirical studies in lower-income countries have examined the association of women's status and power with delivery care use and/or maternal and child health outcomes using DHS datasets. Other studies also explored such association using population-based data from specific regions/settings in the country, or facility-based data on the information of delivery care, births outcomes, and/or characteristics of women who used the service. Scholars assessed delivery care use as SBA use and/or facility delivery, both of which are relevant as they provide evidence of women's delivery care seeking behavior and/or actual use of professional care. Studies have generally found a positive influence of women's status, particularly women's education, on delivery care use. Yet, the evidence is mixed regarding the effect of measures related to women's power and/or empowerment.

#### *Findings from Cross-National Studies*

Pervious examination of women's status, mostly operationalized as women's education, generally indicates positive relationships with delivery care use and outcomes. For example, a cross-national analysis of 64 countries shows that the proportion of SBA use and women's education are more strongly and positively associated with the MMR than are national wealth levels (Shiffman et al., 2000). Women's education is positively associated with SBA use and/or facility delivery in studies in Africa (Singh, 2011; Woldemicael, 2010;

Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011). For example, in a cross-national analysis of eight African countries, women's education is positively related to facility delivery in all countries. The odds are much higher among women with secondary or higher education, from 1.5 times to 5.9 times higher, relative to no education (e.g., OR=1.50 in Egypt, OR=5.90 in Nigeria) (Singh et al., 2011).

However, the effects of other sociodemographic characteristics of women and households do not yield clear patterns across countries. For example, the effect of employment on delivery care use is mixed across African countries – positively in Ethiopia, Eritrea, Liberia, Nigeria and Mali, and negatively in Rwanda and Uganda (Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008). The influence of marital and household relationship (e.g., polygamous/monogamous union; household headship) on women's power and delivery care use is not well studied in Africa. One study in Kenya found no effect of marital relationship status on facility delivery (Kitui et al., 2013). Female-headed household is negatively related to facility delivery in Rwanda (Jayaraman et al., 2008). Another study demonstrates the influence of marital and household relationships on other, more commonly studied reproductive health outcomes (e.g., fertility). For example, polygamous union is associated with a smaller ideal number of children only in Mali, but not

in three other African countries (Upadhyay&Karasek, 2010), suggesting that polygamous unions may connote higher levels of power in some settings, but not necessarily in others.

The influence of the measures of women's power on delivery care use is not well studied relative to that of women's status in Africa. Several of the identified studies did not explicitly examine women's power (Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011). Among studies that included measures of women's status and power, specifically women's household decision-making participation, these measures were generally found to be positively related to delivery care use; however, the results are mixed across countries and regions (Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010). A meta-analysis found that, based on the pooled odds ratios, household decision-making participation was positively associated with SBA use in 31 countries (including 21 African countries) (Ahmed et al., 2010). However, another African study found that women's household decision-making was positively associated with facility delivery only in Nigeria, but not in seven other African countries (Singh et al., 2011).

In Asia, the positive influence of women's power on reproductive health has been generally supported. Yet several DHS studies on delivery care use do not provide clear evidence in Asian countries. In India (in Mumbai), delivery at a health institution is related to women's participation in decision-making on purchases, but not to other domains of women's decision-making (e.g., decision on mobility) (Matthew et al., 2005). Anther Indian

study in West Bengal found no relationship of delivery care use with decision-making and perceptions of gender norms (Basu&Koolwal, 2005). In Bangladesh and Nepal, the relationship between decision-making and delivery care use is not statistically significant, whereas decision-making is positively related to antenatal care use (Story&Burgard, 2012; Allendorf, 2007).

Although most of the previous studies on reproductive health operationalized women's power solely in terms of decision-making power (Malhotra et al., 2002), some DHS studies on reproductive health (e.g., maternal and child health service use, and fertility intention) in Africa examined the effects of additional measures of power, beyond household decision-making, including perceptions of gender norms (Woldemicael, 2010; Singh et al., 2010; Snow et al., 2013; Upadhyay&Karesak, 2010). However, the evidence from these studies is mixed across measures and countries. Together, these studies highlight the importance of identifying and examining the contribution of individual measures of women's status and power to delivery care use and reproductive health. For example, in two multi-country studies examining delivery care use, education is consistently and positively related to facility delivery in ten African countries; however, decision-making is positively related to delivery care use in Eritrea and Nigeria only and progressive perceptions against violence positively related in Ethiopia, Ghana, and Nigeria alone (Singh et al., 2011; Woldemical,

2010). Therefore, the effect of these individual measures of power and their relative contribution on delivery care use is unclear.

Mixed effects are also found for cross-African studies examining the linkages between women's power (e.g., decision-making, gender attitudes) and fertility. Although effects were found for several countries, the statistical significance and magnitude greatly differ by measure and country (Snow et al., 2013; Upadhyay&Karesak, 2010).

Moreover, some important proxy measures of women's status and power are missing from the literature. For example, although patriarchal norms persist and son preference is common in Africa (Fuse, 2008), the implications of having son(s) and its influence on delivery care use is not well studied. Few studies examined the effect of early marriage and/or childbearing on delivery care use. There is only one DHS study that found a positive association between age at first childbearing and facility delivery in Asia (Pandey et al., 2010), while none of the identified DHS studies in Africa examined this association. A recent meta-analytic study in 25 African countries shows that early childbearing is positively associated with more permissive perceptions of gender-based violence, suggesting that early childbearing may adversely affect future empowerment (Hindin, 2012), which in turn can influence reproductive health outcomes and service use including delivery care (WHO, 2011). It should be noted, however, that the influence of early childbearing on perceptions of gender-relation differs by country (Hindin, 2012). Similarly, age at first marriage has also

shown varied associations with fertility intention in the study of four African countries (Upadhyay&Karesek, 2010). These findings suggest the varied influence of early marriage and childbearing on women's power and reproductive health across countries, and highlight the importance to assess the effect of early marriage and childbearing on delivery care use.

Overall, the literature generally suggests the positive relationship of women's power with women's education and other sociodemographic factors (e.g., employment), as well as between women's power and the health of women and their families (e.g., child health, low fertility) (Malhotra et al., 2002). However, the effects of women's power and/or empowerment do not exhibit a clear pattern across countries and appear to be heavily influenced by both the operationalization of the measurements, as well as differences in sociocultural contexts (e.g., historical influences, religion, ethnicity, etc.) that generally affect social norms and gender roles in society. Moreover, in the previous examinations, the way in which women's status, power, and empowerment are conceptualized and operationalized varies across studies. Thus the inconsistency of evidence is likely due, at least in part, to these methodological differences of which women's power and empowerment are conceptualized and operationalized across studies (Malhotra et al., 2002; Upadhyay et al., 2014), as well as differences in methodological approaches.

***Methodological Critique***

There are three, key critiques of the methodologies employed in previous studies on women's power and reproductive health. First, only a few studies explore the structure and dimensions that comprise women's power and examine the relative contribution of each dimension and/or aspect of women's power.

Few studies have assessed the influence of each dimensions/aspects on delivery care use in Africa (Singh et al., 2010; Woldemicael, 2010), finding the disperse influences by measure and country. Additionally, a study of 23 countries using DHS measures of women's power from two dimensions (i.e., household decision-making in four aspects, and gender norms in two aspects) demonstrated that predictors for the individual dimensions and aspects differed greatly within- and across-countries and regions (Kishor&Subaiya, 2008). Although evidence indicates the complex, multidimensional, and culturally-defined nature of women's power and empowerment, only a few studies considered the structure of dimensions and/or aspects using an appropriate statistical approach (e.g., factor analysis) (Woldemicael&Tenkoranga, 2010; Pallitto&O'Campo, 2005; Agarwala&Lynch, 2006; Do&Kurimoto, 2012) or the independent contributions of different dimension/aspects of power on reproductive health (Pallitto&O'Campo, 2005; Story&Bugard, 2012; Woldemicael, 2010; Singh et al., 2010; Snow et al., 2013; Upadhyay&Karesak, 2010).

Second, related to the aforementioned concern is that many of the existing DHS studies operationalize women's power using summative variables or indices, which may not always reflect the variations in influences within and across related indicators. Findings from existing studies indicate that different levels of participation in decision-making (e.g., sole, joint, or none), as well as specific domains in which women are engaged (e.g., household purchase, health care seeking), could have different influences on delivery care use (Woldemicael, 2010; Story&Bagard, 2012). For example, the DHS study in Eritrea and Ethiopia found that only joint decision-making on purchasing large items in Eritrea had a significant positive association with facility delivery, as compared to sole decision-making (Woldemicael, 2010). Despite the debate over the operationalization of decision-making power (e.g., alone versus any form including alone/joint), few published studies on reproductive health employed different operationalizations (Allendorf, 2007).

In previous studies, several scholars summed the number of household decisions in which women participated (i.e., alone or jointly) and created a binary variable to indicate if women participated in all household decisions or not (Singh et al., 2011; Upadhyay&Karasek, 2010). A binary variable was also used to demonstrate if women can negotiate different aspects of sexual relationships (Do&Fu, 2011) and if women do not justify violence at any situation (Woldemicael, 2010). Although binary variables may be employed due to skewed distributions and to facilitate interpretation, the coefficients do not inform the

variations of effect per the degree of women's power. Hence, the results and interpretations can be less meaningful as compared to other types of variables (e.g., continuous or ordinal). Some studies created one composite index for empowerment based on various dimensions/aspects (e.g., contribution of household income, decision-making, perceptions of gender norms) (Do&Kurimoto, 2012). Such variations in the operationalization of women's power hinder the synthesis of evidence across studies.

Third, none of the identified studies on delivery care compared the different structure of women's power measures, using different types of variables (e.g., binary versus continuous). The study on contraceptive use in four African countries showed different conclusions by operationalization and the varied influence of each dimension that comprises the index. For example, in Ghana, it was only perceived agreement in fertility that was positively related to contraceptive use, whereas the other five measures were not significantly related (Do&Kurimoto, 2012). Thus the rationale for using the index is unclear, which may mask the influence of each dimension, highlighting the importance to compare different operationalizations.

Fourth, analyses were mostly conducted through descriptive, bivariate and/or multivariate analyses, and few studies conducted theory-based analyses including the assessment of pathways involving mediators. Theory-based analysis is essential when examining the complex mechanisms underlying women's use of SBA. In particular, the

mediation effect of women's power, or empowerment as a process, is rarely examined using a formal test (e.g., mediation tests). Evidence of moderation effects by sociocultural factors is also scarce and prevents our understanding of the conditional effect of women's status and power on delivery care use. There is one of the few studies on delivery care use that explored moderation and mediation in Africa. For example, a household study in urban Kenya assessed the effect of women's autonomy (based on decision-making and freedom of movement) on delivery care use, and found moderation by household wealth, while women's autonomy did not mediate the relationship between women's education and the place of delivery (Fotso et al., 2009).

Moreover, despite the recognition of complex mechanisms surrounding women's power and its influences on health outcomes, to date, there are no studies on delivery care use that use Structural Equation Modeling (SEM). There is only one identified study in the broader reproductive health literature that used SEM to examine the influence of women's self-efficacy on condom use in Vietnam (Do&Fu, 2011), although even this study did not examine the mediation effect of self-efficacy on the relationship between women's sociodemographic characteristics and condom use. Several of the articles referred to theory and/or conceptual models (e.g., gender theory, the three delays model); however, none of the identified studies statistically tested any theory that involved multiple pathways in a complex mechanism.

## 1.3. Theoretical Framework and Theory-based Study Findings

This dissertation employs gender theories to understand the determinants of delivery care use. Sociological perspectives, in particular the theory of gender stratification, help us to understand and frame some of the underlying social issues that contribute to women's reluctance or inability to seek reproductive health services, leading to negative health outcomes such as maternal mortality.

Some theorists attempt to explain gender-based differences in privilege and power in society, highlighting the effects of women's subordinate socioeconomic status and those of power differences between men and women on sexual and reproductive health behaviors and outcomes (Blumberg, 1984; Connell, 1987). Feminist scholars have advocated for the better understanding of women's sexuality and sexual power affecting health outcomes through analyses that incorporate culture, social and economic values, and politics in society and gender relations (Amaro, 1995; Amaro et al., 2001). The importance of addressing women's health needs – through advancing women's power and achieving more equitable gender relations – have been identified as critical components in the improvement of sexual and reproductive health outcomes (Amaro, 1995; Amaro et al., 2001). Gender equality and women's empowerment are also widely recognized as critical to the achievement of global development goals, including maternal health (World Bank, 2012; French Gates, 2014).

### *The Theory of Gender Stratification*

The Theory of Gender Stratification emphasizes the effect of social structure on gender inequity at different levels – household, community, class, and larger society – contexts in which women are nested and in which their relative power and status are determined (Blumberg, 1984). The most important form of women's power is their economic power relative to men, understood as "relative control over the means of production and allocation of surplus" (p. 25, Blumberg, 1984). The theory describes economic power as a "mediating force" for other forms of power (e.g., the power of force, politics and ideology). For women, relative economic power is seen as varying at the micro- and macro- levels, ranging from the household to the state. In particular, in the context of reproductive health, the higher women's economic power, the higher (1) their control over their own lives; (2) the likelihood that her fertility pattern will reflect her own perceived utilities; and (3) her control over a variety of other "life options" including marriage, divorce, sexuality, and household authorities (Blumberg, 1984).

The extension of the theory was later suggested by Blumberg and Collins et al. (1993) who argued that the theory should be expanded to examine each sex's participation in childbearing and its effect on socioeconomic participation and power, as a part of the fundamental conditions leading to gender stratification, from household to larger society level (Collins et al., 1993). In particular, the theory postulates that: (a) a relatively higher female

position in the society makes men take more responsibility for childcare, resulting in greater participation of women in the labor force and increasing their political involvement and ideology; (b) men are likely to regard women as objects to be protected and controlled in societies with high birth rates with a sharp separation of gender spheres; and hence (c) women's power, their income and external social involvement are likely to be reduced due to their full commitment to childcare (Collins et al., 1993). Thus, early childbearing can have negative effects on women's advancement of their socioeconomic and political participation and status, resulting in inequitable power and resource relative to their partners.

Therefore, gender theories highlight the need to address gender-related issues as underlying factors for delivery care seeking and outcomes, including women's relative economic power; decision making power (e.g., life options and household matters); participation in childbearing, and marriage as a proximate determinants of childbearing; and participation in labor market. In the Method chapter (Page 45), I will discuss how these theories will be integrated into the conceptual framework for this study.

***Findings and Methodologies of the Theory-based analysis***

Although gender theories provide a useful framework to examine the influences of sociocultural context of gender and sexuality on women's health, only a few studies have incorporated gender theories when assessing the effect of women's status and power on

delivery care use in Africa. Most of the existing studies focus within Asia, yet they generally support the relevance of gender theories to examine maternal and child health behaviors and outcomes. These findings are summarized below.

A study employing the Theory of Gender Stratification in Indonesia found that women's greater power relative to their husbands was positively associated with prenatal and delivery care use (Beegle et al., 2001). The measure of power included the relative social status between the couple (i.e., the perceived social status of their own family); the relative education status between the couple and between their fathers; and the control over economic resources (Beegle et al., 2001).

Another set of studies used the Theory of Gender Stratification to examine child mortality in lower- and middle-income countries. In these studies, country-level measures of women's status (e.g., female school enrollment and literacy rate, average age at first marriage, etc.) consistently demonstrated a negative association between women's education and child mortality, as well as a correlation between maternal mortality and child mortality, suggesting a positive effect of women's status on maternal and child health (Boehmer&Williamson, 1996; Frey&Field, 2000; Shen&Wiliamson, 1997).

These findings are supportive of the use of gender theories in low resource settings, such as Africa, and demonstrate that theory-driven analyses are likely to be useful in examining maternal health behaviors and outcomes.

### 1.4. Justification for the Design of the Present Study

Examination of existing literature and theories highlight five critical research gaps that need to be addressed when attempting to understand the determinants of delivery care use in SSA. First, measures that address *the multidimensionality of women's power* should be examined in reference to the empowerment definition by Kabeer (2001). The structure of power and comprising dimensions should be identified, based on an appropriate statistical approach (e.g., factor analysis), and the differential effects of each dimension/aspect on SBA use should be examined using theory-driven analysis.

Second, as a part of the concept of women's power, or empowerment as a process, the effect of women's decision-making regarding strategic life decisions should ideally be assessed. Specifically, *the effect of life-strategic events including early marriage and childbearing on women's power and SBA use should be assessed,* according to theory and evidence indicating their negative influence on women's power, empowerment, and delivery care use and outcomes. Clear evidence of their negative effects can make a stronger case for enhancing policy and program interventions to prevent early marriage and childbearing.

Third, the underlying causal mechanisms affecting SBA use should be formally assessed, especially *a pathway from women's status, through women's power, then to SBA use.* In accordance with theory, mediation effects of women's power should be assessed using formal tests (e.g., mediation tests, structural equation modeling) for potential causal inference.

Fourth, given the contextual nature of empowerment, *a better understanding of the influences of sociodemographic factors* can inform interventions to improve delivery care use in a specific setting. Their influence on women's power and SBA use should be explicitly assessed, which may confound the relationship of SBA use with women's status and power, including household and marital relational characteristics. As a part of control variables, perceptions of delivery care use, including the perceived accessibility of health care as well as the perceived quality if it were available, should be included in the analysis, because this may provide an alternative explanation of SBA use.

Lastly, *the heterogeneity of African countries should be considered when examining determinants of SBA use and mechanisms,* as is demonstrated in existing cross-country studies in Africa, as well as cross-regional studies (Ahmed et al., 2010; Singh et al., 2011; Magadi et al., 2007; Woldemicael, 2010). In-depth individual country assessment, as well as comparisons to the other countries, is necessary to identify the determinants of delivery care use that are similar across settings, as well as mechanisms that may be unique to specific settings. This information will be helpful in informing more contextually-appropriate interventions.

## 1.5. Study Settings – Senegal and Tanzania

The settings for this study are the Republic of Senegal located in Western Africa, and the United Republic of Tanzania in Eastern Africa. I chose these two countries because they share some reproductive health characteristics, but they are very different in terms of the social, economic, cultural, and political environment in which women live. I briefly describe the characteristics of each country below.

There are distinct differences in the sociocultural contexts of pregnancy-related care in Tanzania and Senegal. Their distinct sociocultural history and context (e.g., colonial history, administration, policy, and religion) may lead to diverse social norms affecting women's status and power, and consequently health beliefs and behaviors. My work experience in both countries also exposed me to their distinct sociocultural contexts, which are often different from common understandings. For example, despite the general interpretations of Muslim women in polygamous societies as having relatively lower status than those in monogamous societies, I observed several advantageous features and assets of Muslim Senegalese women (e.g., social network, economic power, local labor and political participation) relative to that of non-Muslim Tanzanian women. This observation of the complexity of women's status and power in the real world has lead me to hypothesize that there are differential effects of women's status and power on reproductive health and diverse pathways among these determinants. These potential differences in women's participation in

socioeconomic and political spheres in the two settings may imply that women have different elements of "resources" and "agency" for power and empowerment, as well as differential modalities for using or exercising them, resulting in their disparate effects on reproductive health service use, including delivery care.

The literature also highlights the contrasts between these two settings from the perspectives of history, culture, religion, government policy, and health systems. In general, Islamic traditions are believed to negatively influence women's status, yet Senegalese women have been renowned in their socioeconomic and political participation due to local women's organizations and governmental efforts (Sieveking, 2007; Patterson, 2002). Their socioeconomic and political power, as well as freedom of mobility, is understood to be indicative of women's higher empowerment status. They also are the important determinants of delivery care use in Senegal, because women's low status and empowerment are found to be negatively related to maternal health service use (Faye, 2008, 2010). In Tanzania, traditional customs have generally prevented women's activities outside the household (Croll, 1981). Yet there are recent shifts in sociocultural traditions and norms (e.g., arranged marriage, dowry, and polygamy) which appear to have advanced women's status and power and promoted reproductive health behaviors and service use (McCloske et al., 2005; Lausen&Hollons, 2003). In Tanzania formal education is more prevalent than it is in Senegal;

thus, women's education may be viewed differently across these two countries given differences in the average levels of female education and literacy across these two settings.

The legal frameworks in these countries regarding marriage are also different. In Senegal, girls can be married at age 16 with parental consent and age 18 without consent (Senegal family code, 1972). In Tanzania, while the Child Act (2009) is endorsed in accordance with the Convention of the Rights of the Child for marriage at age 18, the Marriage Act (1971) approves marriage of girls at age 14 with parental consent and age 15 without consent.

As shown in Table 1, these two countries have both differences and similarities in socioeconomic and health indicators. General country indicators, including the population density and the literacy rate of youth age 15-24 are similar, but the national GDP in Senegal is twice that of Tanzania, a factor that may likely impact levels of household wealth and its influence on women's power and SBA use. Overall, child health and fertility indicators are similar in the two countries. With maternal health, the MMR and the progress of reduction are similar. Progress in increasing the proportion of SBA use is much faster in Senegal than Tanzania, and the trend of health service availability also differs across these two settings. Half of recent births (50.2%) occurred at health facilities in Tanzania, as compared to almost three quarters (72.8%) in Senegal (NBS Tanzania&Macro, 2012; ANDS Senegal&Macro, 2012). There are more health facilities (in terms of density per population), but relatively

fewer health professionals available in Tanzania than in Senegal (WHO, 2010, 2014; Tanzania ministry of health&WHO, 2007).

Additionally, descriptive statistics show that women's status, their household decision-making power, and their perceptions of gender-role norms differ greatly in these countries (See Descriptive section in Method chapter). This is likely to explain the differential implications of women's status and power in these settings, as well as their sociodemographic determinants. These potential differences of women's status and power in a given society relative to men are likely to lead to varied health behaviors and outcomes by setting, including delivery care use and other reproductive health behaviors and outcomes. Therefore, the comparisons of determinants affecting delivery care use and their mechanisms under distinct sociocultural contexts are of research interest.

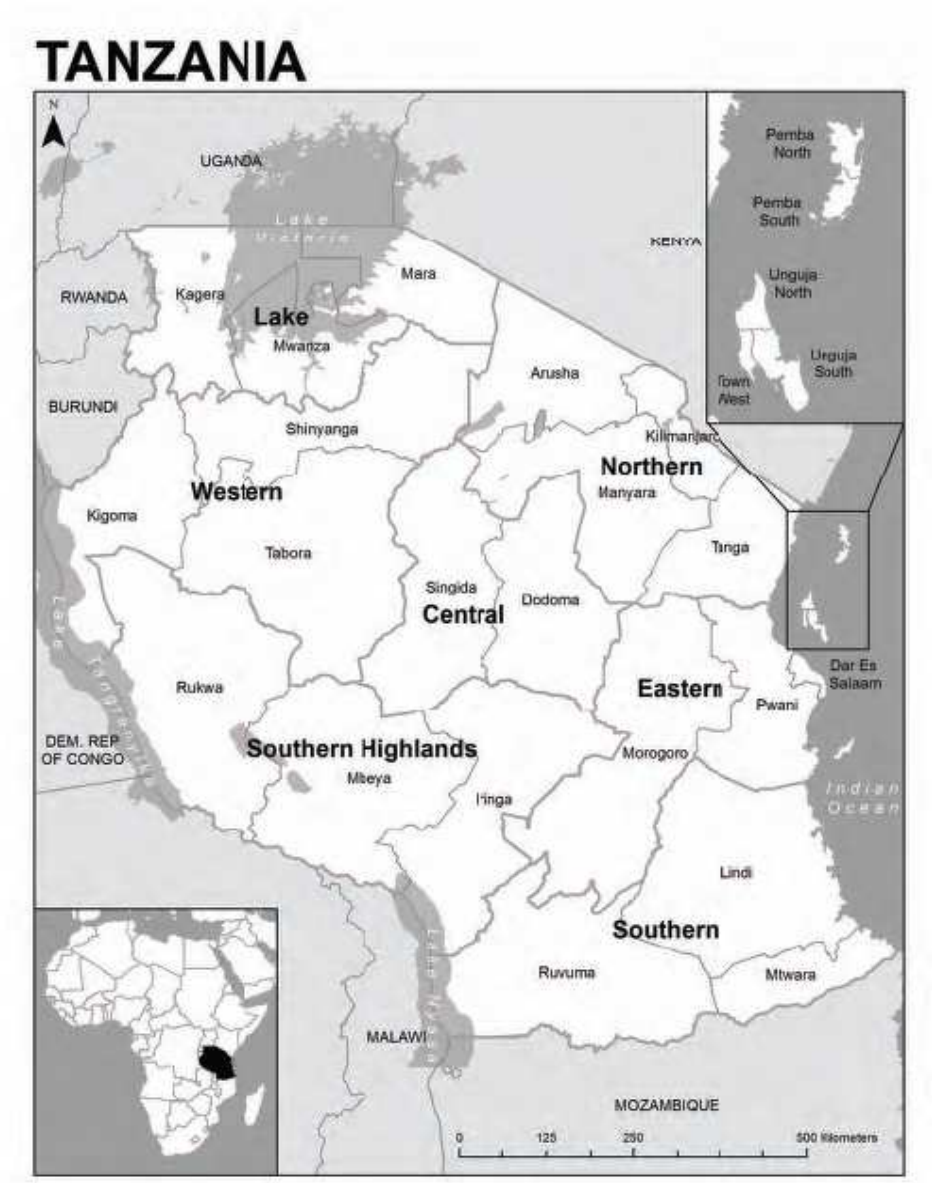
Table 1. General Country Characteristics and Socioeconomic and Health Indicators, Senegal and Tanzania.

| *Indicators* | | *Country* | |
|---|---|---|---|
| | | ***Senegal*** | ***Tanzania*** |
| **I: General country characteristics** | | | |
| | Land area (km2) | 196,722 | 940,000 |
| | Population (million) | 13 (in 2010) | 43 (in 2010) |
| | Population density | 64 (in 2010) | 51 (in 2010) |
| **II: Socioeconomic indicators** | | | |
| | Literacy rate of age 15-24 (percent) | 65 (in 2009) | 77.3 (in 2010) |
| | Religion | 94% Muslim<br>4% Christian<br>2% Others | Not officially available |
| | Gross Domestic Products per capita (in USD) | 1 032.7 (in 2010)*a | 516.2 (in 2010)*a |
| | Gross National Income per capita (in USD) | 1 011.3 (in 2010)*a | 514.4 (in 2010)*a |
| **III: Health indicators** | | | |
| | Maternal mortality ratio (per 100,000 live births) | 370 (in 2010)<br>670 (in 1990)<br>44.8% reduction | 460 (in 2010)<br>870 (in 1990)<br>47.1% reduction |
| | Skilled births attendant use (percent) | 65.1 (in 2010)<br>47.2 (in 1993) | 48.9 (in 2010)<br>43.9 (in 1992) |
| | Total Fertility Rate (per women) | 5.0 (in 2010) | 5.4 (in 2010) |
| | Age-specific fertility rate age 15-19 (per 1,000 women) | 116 (in 2010) | 116 (in 2010) |
| | Infant mortality rate (per 1,000 births) | 50 (in 2010) | 50 (in 2010) |
| | Under-5 mortality rate (per 1,000 births) | 75 (in 2010) | 73 (in 2010) |
| | Life expectancy (years) | 59.6 (in 2012)*b | 58.9 (in 2012)*b |

Sources: *a – UN statistics division 2013; *b- Human Development Report 2013 by United Nations Development Program; Senegal DHS 2010-2011 or Tanzania DHS 2010 unless specified.

Figure 1.1. Map of Senegal (Source: DHS Senegal 2010)

Figure 1.2. Map of Tanzania (Source: DHS Tanzania 2010)



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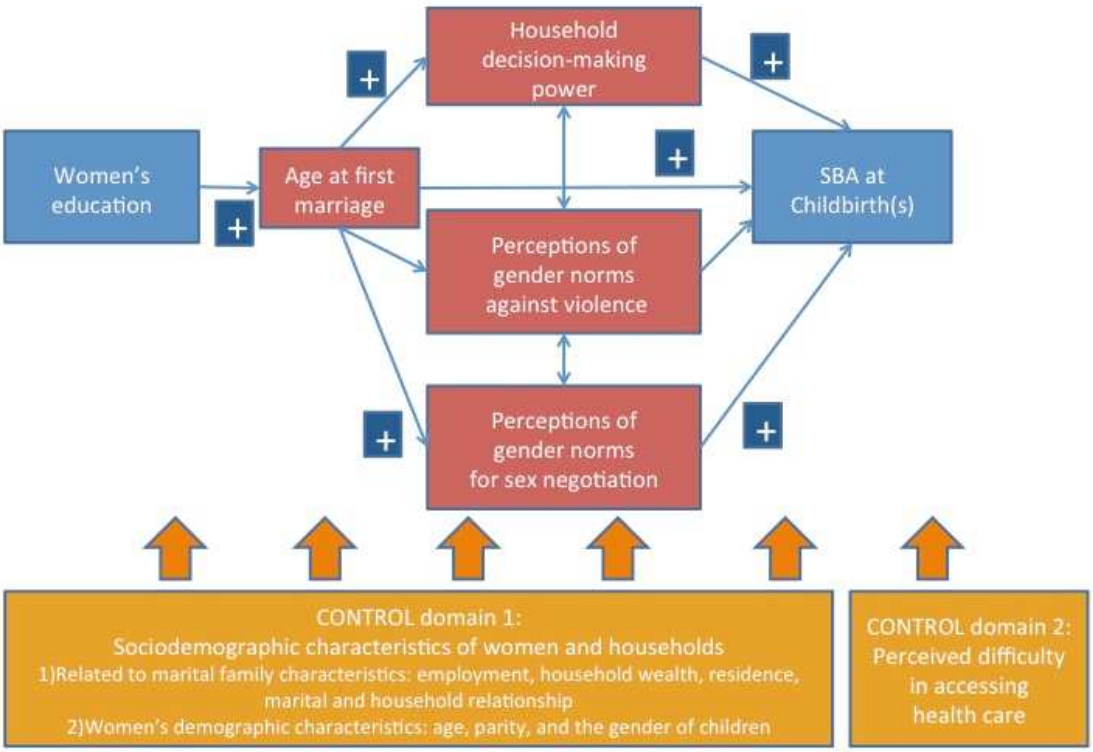
# Chapter 2. Method

## 2.1. A Proposed Conceptual Framework

An integrated conceptual framework was developed based on the aforementioned theories and empirical findings, and was tested in this study (Figure 2.1) to understand and predict SBA use at childbirth in sub-Saharan Africa. This framework, informed by gender theories, primarily focuses on women's status and women's power, which have been identified as determinants and underlying sociocultural factors affecting delivery care use and reproductive health outcomes. In particular, these gender theories suggest that women's status and power positively influence reproductive health care use, including delivery care use (Blumberg, 1984; Connell, 1987; Collins et al., 1993).

Figure 2.1: An integrated conceptual model: Use of Skilled Birth Attendants in Sub-Saharan Africa.




This framework primarily focuses on socioeconomic/cultural factors and their pathways to SBA use. My analysis examines women's education as a focal independent variable. According to the gender theories, the framework integrates measures of women's status and power to understand their association with SBA use.

In my dissertation analysis, women's household decision-making power and perceptions of gender norms against violence and for sex negotiation are included as proxies for women's power. In subsequent dissertation chapters I use the term "women's power" to refer these constructs to approximate power/proxies of power. In alignment with the

terminology used in the public health literature I use the term "(proxy measures of) empowerment" for women's power in the three research aim dissertation papers (Chapters 3-5). Age at first marriage is also included as a proxy measure based on evidence of its associations with early childbearing, women's power, and reproductive health behaviors and outcomes (Bongaarts, 1978, 1982). Other sociodemographic characteristics of women and households are included as control variables, as well as perceived accessibility of health care. These sociodemographic characteristics can be classified as those related to: 1) women's individual characteristics; 2) women's natal family; and 3) women's marital family. The first category includes women's age, employment, parity, and gender composition of children; the second includes women's education and age at first marriage; and the third includes household wealth index and residence. It is noted that parity and employment are also likely to be influenced by characteristics of the marital family.

In Figure 2.1, it is hypothesized that the positive relationship between women's education and SBA use is mediated by women's age at first marriage, household decision-making power, and perceptions of gender norms. These hypothesized pathways are supported by Kabeer's empowerment definition (2001) and other gender theories (Blumberg, 1984; Connell, 1987; Collins et al., 1993). Specifically, my framework suggests that women are more likely to use SBA if: 1) they are married at older ages; 2) their household decision-making power is higher; and 3) their perceptions of gender norms are more progressive (e.g.,

they do not accept domestic gender violence by husbands, and perceive the ability to negotiate about sexual relationship with husbands). These measures are suggested by Kabeer's empowerment definition (2001) as separate dimensions for empowerment. The sequencing of the pathways, specifically women's education as a predictor of age at marriage and women's power, is supported by descriptive statistics from these samples indicating that women stop schooling first and then get married (See Descriptive Analysis section 2.6, Page 91).

This conceptual framework incorporates two main issues identified in the literature as persistent gaps in examining the linkages between women's power and SBA use. First, this analysis considers the multi-dimensionality of power and highlights the importance of examining the individual effects of these constructs/dimensions on delivery care use. Second, this framework considers the potential confounding effects of sociodemographic characteristics of women and households, as well as perceived difficulty in accessing health care, on the relationship between women's education and SBA use (Thaddeus&Maine, 1994). It is particularly important to examine the relationships between these constructs and their effects on SBA use given the inconsistency of the evidence and the inherent complexity of examining on the role of women's power on these and other sexual- and reproductive health-related decisions.

## 2.2. Aims and Hypotheses

The overall aim of the dissertation is to investigate pathways linking women's status and power – education, age at first marriage, decision-making power, and perceptions of gender norms – to SBA use in Senegal and Tanzania. The dissertation is comprised of three standalone papers that address each of the three research aims and related hypotheses:

***AIM1: To examine the association of women's status, age at first marriage, decision-making power, and perceptions of gender norms with SBA use in Senegal and Tanzania.***

As indicated in Figure 1, I use women's education as a proxy for women's status. Other key variables are women's power: 1) age at first marriage; 2) women's household decision-making power; 3) perceptions of gender norms against violence; and 4) perceptions of gender norms for sex negotiation, all of which are assessed separately.

Hypothesis 1-1. Women's education is positively associated with SBA use, net of sociodemographic characteristics and perceived accessibility of health care.

Hypothesis 1-2. Women's education is positively associated with age at first marriage, household decision-making power, and perceptions of gender norms, net of sociodemographic characteristics.

Hypothesis 1-3. Women's education, age at first marriage, household decision-making power, and perceptions of gender norms are positively associated with SBA use, net of sociodemographic characteristics and perceived accessibility of health care.

***AIM2: To examine the mediation effects of age at first marriage, women's decision-making power, and perceptions of gender norms on the relationship between women's status and SBA use in Senegal and Tanzania.***

Hypothesis 2-1. Age at first marriage mediates the relationship between women's education and SBA use in Senegal and Tanzania.

Hypothesis 2-2. Women's household decision-making power mediates the relationship between women's education and SBA use in Senegal and Tanzania.

Hypothesis 2-3. Perceptions of gender norms against violence and for sex negotiation mediate the relationship between women's education and SBA use in Senegal and Tanzania.

Hypothesis 2-4. Age at first marriage, women's household decision-making power, and perceptions of gender norms mediate the relationship between women's education and SBA use in Senegal and Tanzania.

***AIM 3: To test the pathways between women's status and SBA use, through age at first marriage first, and then decision-making power and perceptions of gender norms in Tanzania.***

Hypothesis 3. The relationship between education and SBA use is sequentially mediated by three constructs: age at first marriage, then household decision-making power and perceptions of gender norms in Tanzania.

Under this hypothesis, the mediation of four potential mediators in sequence is tested (but not in parallel as tested under Aim 2), on the focal relationship between education and SBA use. Specifically, pathways are anticipated that education positively affects age at first marriage, which in turn positively affects household decision-making power and perceptions of gender norms against violence and for sex negotiation, which then together positively affect SBA use. This distinction between the two aims is depicted in Figure 2.2 (for Aim 2, Page 81) and Figure 2.4-2.5 (for Aim 3, Page 87-88).

## 2.3. Dataset

(1) Survey Design and Sample: This study employs the Demographic and Health Survey (DHS) dataset, a nationally-representative household survey that collects data on a variety of population, health, and nutrition issues. The survey is conducted in lower-and middle-income countries approximately every five years by the MEASURE (Monitoring and Evaluation to

Assess and Use Results) DHS program funded by the USAID (U.S. Agency for International Development). DHS surveys collect primary data using several types of questionnaires for women, households, couples, and men. For this study, the latest survey datasets from Senegal in 2010-2011 and Tanzania in 2010 are examined.

The DHS uses a two-stage sampling procedure. In Senegal, 28 strata were created according to the existing districts in the first stage, and then 391 clusters were created as a sample point based on the listing of the number of household per district. In Tanzania, 475 clusters were selected based on the list of enumeration areas in the 2002 Population and Housing Census. Twenty-five points were selected in Dar es Salaam; 18 were selected in each of the other twenty regions in mainland Tanzania, yielding 360 points. In Zanzibar, 18 clusters were selected in each of the five regions, yielding 90 points.

In the second stage, a complete household listing was carried out in all selected clusters, and households were then systematically selected for participation in the survey. Twenty-one households were selected from each of the clusters in all regions in Senegal, yielding a total of 8,232 eligible households. In Tanzania, 22 households per cluster in all regions were selected, except for Dar es Salaam where 16 households per cluster were selected, yielding a total of 10,300 eligible households. In Senegal 7,902 households were interviewed, whereas in Tanzania 9,623 households were interviewed. The successful

interview rates for households (i.e., the household response rates) were 98.4% in Senegal and 98.9% in Tanzania.

All women ages 15-49 who were permanent residents in the households or visitors present in the household on the night before the survey were eligible to be interviewed. In Senegal, 16,931 women were identified for individual interview; complete interviews were conducted with 15,688 women, yielding a 92.7% of successful interview rate (i.e., "eligible women response rate") among the visited households. In Tanzania, 10,522 women were identified and 10,139 women completed interviews (96.4%). This resulted in 49.6% of women in Senegal and 5.1% of women in Tanzania who were interviewed from the same household. The overall response rate was calculated as the household response rate multiplied by the eligible women response rate divided by one hundred, resulting in 91.2% of all participants being interviewed in Senegal and 95.2% in Tanzania. Data collection was conducted by trained field staff from October 2010 to April 2011 in Senegal; from December 2009 to May 2010 in Tanzania.

The DHS survey weights adjust for differences in the probability of selection and interview among cases in the sample. These weights also account for the uneven probability of data collection among under-represented sub-groups. There are only two sampling weights – individual and household weights. The household weight for a particular household is the inverse of its household selection probability multiplied by the inverse of the household

response rate of its household response rate group. The individual weight of a respondent's case is the household weight multiplied by the inverse of the individual response rate of her individual response rate group. The Primary Sampling Unit (PSU) is "a number assigned to sample points to identify the primary sampling units for use in the calculation of sampling errors" (DHS Macro, 2006). Sample strata define the pairings or groupings of primary sampling units used in the calculation of sampling errors when using the Taylor series expansion method (DHS Macro, 2006). In all statistical analysis procedures for this dissertation, the survey analysis commands were used in statistical programming to account for the individual weight, PSU, and strata.

(2) Study Sample: The study sample consists of all births reported by married women that occurred during the five years preceding each survey (See Annex A). The information of birth assistance is collected on the births during this period. The total number of women who gave birth during this period was 5,349 (unweighted) in Tanzania and 8,146 in Senegal (with the total number of births in this period – 8,023 in TZ and 12,326 in SN). Questions on women's decision-making power were asked of married women only; thus unmarried women were dropped from the analysis (847 in TZ; 576 in SN). To assess the potential impact of excluding births to these unmarried women, the descriptive analysis of key variables is also conducted separately for married and unmarried women, and the statistical significance of

their differences is assessed using bivariate association tests (See sensitivity analysis section, Page 103).

Furthermore, a few women were dropped for missing data on the decision-making questions (n=11 in TZ) and the gender norms questions (n=82 in TZ; 119 in SN). Some observations were missing control variables, including the perceived difficulty in accessing health case questions (n=17 in TZ) and marital relationship variables (n=32 in TZ). The proportion of missing observations is marginal – 1.6% (Senegal) and 2.1% (Tanzania) of female sample respectively (1.5 % over the potential birth sample in SN and 2.0 % in TZ), thus the potential risk of bias due to missing is negligible (Bennett, 2011; Schafer, 1999). The number of women in the analytic sample is 4,445 (weighted) and 4,409 (unweighted) in Tanzania; 7,033 (weighted) and 7,451 (unweighted) in Senegal. For this study, the final study sample includes births during the preceding five years to these married women ages 15-49. There were 24 births in Tanzania and 4 births in Senegal of which the information of birth assistance was missing, so they were dropped. The total number of births during the five years preceding the survey to women with all required information is 6,748 (weighted) and 6,756 (unweighted) in Tanzania; 10,668 (weighted) and 11,431 (unweighted) in Senegal.

Including all births in the preceding five years in the study means that women having more than one birth would therefore be represented multiple times in the study sample. The distribution pattern of multiple births is almost identical in both settings. In Tanzania 45.4%

of women (2,017 women weighted) in the analytic sample had more than one birth, as compared to 45.0% (3,167 women) in Senegal in the given period, with the weighted mean number of births 1.524 (ranges 1-6 in TZ) and 1.517 (ranges 1-5 in SN), respectively. Without adjusting for multiple births occurring to the same women, the standard errors of coefficients would be under estimated and the confidence interval would be too narrow.

For determining the appropriate ways to deal with this problem, I first calculated the Intra Class Correlation (ICC) using STATA (with "loneway" command). The ICC is the proportion of the variance in the data that is explained by the variation between clusters (i.e., women) over the total variance (that is explained by both between and within cluster variances). The ICC was 0.57 in Tanzania and 0.64 in Senegal (score range 0-1). This means that 57% of the variance of SBA use (over the total variance explained by both between and within women variances) is between women – that is, the majority of variance of SBA use comes from the differences between women (i.e., between clusters) in Tanzania, and 64% in Senegal. Based on the ICC, I calculated the design effects as "1 + (average number of birth per woman- 1) * ICC" to assess the non-independence of births within women in my analysis. The design effects are 1.31 in Tanzania and 1.34 in Senegal, which are below the recommended cut-off point of 2.0 (Muthen&Satorro, 1995).

These results suggest that the level of non-independence within women in my study sample can safely be ignored. Thus I conduct the analysis using single level models for

clustering, but not multi-level modeling, in both countries (Williams, 2000). Given that the study examined the multiple births per woman, who are nested in the household, I correct the underestimated standard errors for clustering by woman and household (i.e., expand the confidence interval) (by adding "cluster" command in SAS). Taylor Series linearization method is used in the regression analysis, which estimates the variance of the outcome based on the variance among the survey stratum and PSUs (Williams, 2000; Lohr, 2009).

Both the birth-based and woman-based analyses entail advantages and limitations. The advantage of the birth-based analysis is that it is statistically representative of all births in a given period. The sample size is larger than that of the woman-based analysis, thus sampling errors can be smaller. However, in the birth-based sample, there may be over-representation of women who had multiple births and may not be representative of the total population of women. The birth-based analysis may lead to a lower estimate of delivery care use, because women with lower social status (e.g., lower education and rural residence) who are less likely to utilize an SBA are also more likely to have multiple births in the study period (Bell, 2003). The woman-based analysis addresses the issue of potential over-representation of these women; however, the use of the most recent birth can result in biased results, unless one birth is selected randomly per woman.

In my study sample, the majority of women (55.0% in SN; 54.6% in TZ) had only one birth in the given period. The proportions of SBA use are almost identical over both the

most recent birth and all births in the given period (See Descriptive Analysis section 2.6, Page 89). Indeed, my preliminary regression analysis of the woman-based sample provided almost the same results as the birth-based analysis. Therefore, potential bias due to the choice of sampling approach is likely to be minimal in my dissertation analysis, and both the birth-based and woman-based analysis provide results that can be generalizable to the total population. For my dissertation, I conduct birth-based analysis for Aim 1 and 2. For Aim 3, I use the woman-based sample due to the complexity and lack of methodological guidance in the appropriate use of SEM analysis with clustered or multi-level data.

## 2.4. Variables and Relationships

### 2.4.1. Focal Dependent Variable: Skilled Birth Attendant Use

The use of an SBA at childbirth was operationalized as the use of an SBA at a given childbirth in the five years preceding the survey. As noted above, an individual woman can have multiple children born during this period. Each birth record is included in the analysis and the mother's variables are attached to each birth record. The survey asked: "who assisted with the delivery of (the name of the child)?" The answer options were categorized into (1) SBA (e.g., Doctor or Assistant Medical Officer, clinical officer, nurse or midwife); and (2) Non-SBAs (e.g., MCH aide, village health worker, Traditional Birth Attendant, relative or friend, other (to be specified); and (3) no one. The variable is recoded as binary, in

accordance with the WHO definition of SBAs, where SBAs include trained health professionals but exclude MCH aides who are not trained to assist with childbirth. In Tanzania, SBAs include doctor, assistant medical officer, clinical officer, and nurse/midwife. In Senegal, SBAs are doctor, midwife, and nurse. In the DHS report, an MCH aide, who is trained as a support staff, is counted as "health professional". However, I refer to the WHO definition and classify MCH aide as non-SBA, due to the fact that Tanzanian MCH aides are not trained to assist with childbirth as per the WHO definition.

### 2.4.2. Focal Independent Variable: Women's Education

Women's education served as a proxy measure of women's status in this analysis. Several studies examining the effect of women's status on delivery care use (e.g., SBA use or facility delivery) in SSA employed women's education, and demonstrated a positive association between women's education and delivery care use and/or delivery outcomes (Shiffman, 2000; Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al. 2013; Ochako et al., 2011; Zere et al., 2011). Relevant theories and frameworks also suggest the positive relationship of women's status with power, as well as with reproductive health service use and outcomes (Blumberg, 1984; Connell, 1987; Collins et al., 1993; Thaddeus&Maine, 1994). Thus, I hypothesized that women's education would positively

affect women's power and SBA use. This relationship was assessed net of women's individual and household sociodemographic characteristics (discussed later under control variables section) to account for their potential effects on women's status and power, as well as SBA use.

The survey asked: "What is the highest level of school you attended?" The answer coding options included: no education, primary (7 years in TZ; 6 years in SN), secondary (4 years in TZ; 7 years in SN), and higher. This variable was recoded as: no education; primary attended; and secondary and above attended, because the proportion of women attending secondary or higher was small (See Annex B). Most of the identified DHS studies on delivery care use operationalized women's education as "education level" or "educational attainment" based on the level women attended, and recoded this variable with these three categories (Singh et al., 2011; Magadi et al., 2007; Stepehnson et al., 2006; Jayaraman et al., 2008; Woldemicael, 2010). Given that attendance to primary education is a universal goal (UN, 2014) and the majority of women attended primary education at least in Tanzania, I assigned this group as a reference. For the analysis examining mediation (Aim 2 and 3), a continuous variable of the years of education was used.

### 2.4.3. Mediators: Women's Power

Household decision-making power, perceptions of gender norms, and age at first marriage are potential mediators, which correspond to the three dimensions of the women's empowerment definition by Kabeer (2001). The structure of these constructs and associated indicators were suggested by factor analysis (See Factor Analysis section, Page 100). As suggested by the gender theories and conceptual framework, I hypothesized that women's education would positively affect household decision-making power, progressive perceptions of gender norms, and later age at first marriage. These three measures would then positively affect SBA use, by significantly mediating the relationship between women's status and SBA use. I primarily examined women's power using continuous variables for the dissertation analysis. Examination of the explanatory variables in these large datasets indicates that the variable distributions approximate normality. The utility of categorical measures was also tested (See sensitivity analysis section, Page 109).

(A) Household Decision-making Power: The survey asked married women about their participation in decisions regarding household matters, specifically their ability to decide on their own health care, major household purchases, and visits to family or relatives, with the following question and answer options: "Who usually makes decisions about health care for

yourself/major household purchases/visits to your family or relatives: (1) you, (2) your husband/partner, (3) you and your husband/partner jointly, or (4) someone else?".

The variables were recoded to capture different levels of participation, using categorical and continuous variables. The first option captured three different levels of participation in each household decision separately: (1) women alone, (2) joint decision with husband/partner, and (3) no participation. As the second option, a continuous variable was created to capture the number of decisions in which the woman had *any say* in the decision (i.e., either alone or jointly) (scored 0-3). These options consider the degree of decision-making participation, an improvement upon the existing literature, wherein most studies rely on binary variables after summing up related indicators (e.g., high versus low decision-making) despite evidence of the importance of examining the degree of decision-making participation and its influences on reproductive health (Woldemicael, 2010; Kishor&Subaiya, 2008). Last, a binary variable was created to show if women participated in all three decisions or not, and is examined in the final adjusted multivariate logistic regression model (See sensitivity analysis section 2.9.4, Page 109).

(B) Perceptions of Gender Norms: Perceptions of gender norms were examined across two domains: *perceptions against violence* and *perceptions for sex negotiation*. The survey asked questions regarding women's acceptance of wife-beating and sex negotiations, in order to

measure “women’s acceptance of gender-role norms that endorse the control of women by men” (Kishor&Subaiya, 2008). Specifically, the survey asked: “In your opinion, is a husband justified in hitting or beating his wife in the following situations: if she (1) goes out without telling him? (2) neglects the children? (3) argues with him? (4) refuses to have sex with him? or (5) burns the food? The answer options are binary (i.e., yes or no). Most existing studies have operationalized this construct as a binary variable to represent whether gender violence is justified (fully or partially, in one or more situations) or not (i.e., no justification/acceptance in any of the five situations). I created a continuous variable by summing up the number of situations when women do NOT justify violence (scored 0-5), with higher numbers indicating lower acceptance of gender violence. As a sensitivity analysis, a binary variable (i.e., no justification in any of the five situations, or not) was also examined in the final model (See sensitivity analysis section 2.9.4, Page 109).

The survey also asks about whether a woman feels that she can negotiate with her husband/partner about sexual relations. The survey asked: “Can you say no to your husband/partner if you do not want to have sexual intercourse? Could you ask your husband/partner to use a condom if you wanted him to?” And the answer options are 1) yes (coded 1); 2) no (coded 0), or 3) don’t know, not sure, or depends (coded 8). The variables are recoded into a binary: 1) yes; or 2) no, including those who don’t know, not sure, or depends. A continuous variable was created by summing up the number of situations in

which the woman indicates she can negotiate with her partner (scored 0-2), with higher scores indicating greater perceived negotiation. I also checked the utility of the binary variable to show if the negotiations were accepted in both situations (coded 1) or not (coded 0) in the final model (See sensitivity analysis section 2.9.4, Page 109).

(C) Age at First Marriage: Childbearing and marriage are important life stages. Delaying childbearing and marriage is often seen as an indicator of the amount of power a woman has, or is able to negotiate within her marital relationship. This analysis examines the effect of early marriage as a strong predictor and proximate determinant of early childbearing (Bongaarts, 1978, 1982). Early marriage is measured through the age at first marriage calculated by MEASURE DHS based on the woman's birth date and the date of marriage or union of the respondent as a continuous variable. In the survey, "marriage or union" refers to "being married or living together with a man as if married". Binary variables were also constructed that indicate if a woman experienced early marriage or not. Early marriage is operationalized in two ways: (1) below age 18 as referenced by the Convention on the Rights of the Child as child marriage that is prohibited (UNICEF, 1989); and (2) below age 16 as referenced by the national law as illegal even with a parental consent for Senegalese girls (Senegal family code, 1972), while it is below age 14 for Tanzanian girls (Tanzania marriage act, 1971). The utility of the binary variables was checked in the final model (See sensitivity

analysis section 2.9.4, Page 109). I anticipated that the higher the age at first marriage, the higher the level of women's power and the more likely they use an SBA.

### 2.4.4. Control Variables Domain 1: Sociodemographic Characteristics

The following sociodemographic variables are included in the analysis as potential confounders for the focal relationship between women's education and SBA use and are supported by previous analyses: women's age, parity, employment for payment, household wealth, marital and household relationship, the gender composition of children, and the place of residence. These variables represent the sociodemographic status of women and households, and are often found to have significant associations with delivery service use, as well as women's power, in low-resource settings (See Background chapter 1.2.3, Page 8).

(A) Women's Age: Women's current age in years was calculated by MEASURE based on the date of birth of the respondent and the date of interview as a continuous variable. The descriptive analysis of women's characteristics shows women's current age at the time of interview. In the analysis of SBA use using regression and SEM, women's age at the delivery was included. Women's age at the time of delivery was calculated based on the date of birth of the respondent and the date of the delivery as a continuous variable. This variable was also recoded as categorical, because there may not be a linear trend in its effect on SBA use. The

categories include: (1) age 15-19; (2) age 20-29; (3) age 30-39; and (4) age 40-49. I anticipated that adolescents would be less likely to use SBA due to sociocultural taboos for adolescents to use reproductive health services; those of young and middle age group (e.g., age 20-39) be less likely to use SBA, because they are likely to have delivered previously and less concerned about the risk of delivery; and those of older age group are more likely to use an SBA, because they may perceive a higher risk of delivery later in the reproductive lifespan. Yet a preliminary analysis found that there was a linear relationship – that is, the higher the age category, the higher the likelihood of using SBA use both in Senegal and Tanzania in the fully adjusted multivariate model, whereas bivariate associations were not significant. Thus a continuous variable is included in the dissertation analysis. I anticipated that women of lower ages would be likely to have lower levels of power and be less likely to use an SBA as compared to women of older ages.

(B) Parity was defined as the number of live births the mother has had. In the DHS, there are two variables related to parity that are attached to women: 1) the total number of living children is the sum of questions on living son(s) and daughter(s) in and outside the home (v218); and 2) the total number of children ever born (v201). The latter was reported in the descriptive analysis of women. The means of these two variables are almost the same, while

the number of living children is slightly lower than the total number of birth because of child mortality (data not shown).

Moreover, there is another variable attached to births – the birth order of each birth in the birth record of each woman. In my dissertation analysis I used this variable because my analysis primarily used birth as a unit of analysis. Parity was assessed as a categorical variable in reference to previous studies (Singha et al. 2011; Magadi et al. 2007; Upadhyay&Karesak, 2010; Woldemicael&Tenkorang, 2010; Jayaraman et al. 2008), because there may be a non-linear trend. Categories were created as: first birth; second or third birth; and fourth or more. The last group (i.e., fourth or more) was selected as a reference because of its larger proportion than others. I anticipated that women with very low or high parity would be more likely to use SBA, because of little or high delivery experience that can be associated with higher perceived risk of negative delivery outcomes, as compared to mid-range parity levels (the weighted mean of the total number of children ever born is 3.81 in Senegal; 3.90 in Tanzania). In Aim 1 the categorical variable was used, and an inverse relationship was observed, such that the lower the category of birth order, the more likely to use SBA in both countries. Thus a continuous variable was used for Aim 2 and 3 when included as a control variable. Given that high parity is likely to result from early marriage and childbearing that are associated with low level of power, I anticipated that high parity would be also associated with low level of power.

(C) Women's employment was assessed by asking the woman whether or not she worked in the last 12 months. The survey asked "aside from your household work, have you done any work in the last seven days?"; if not it asked "do you have any job or business from which you were absent for leave, illness, vacation, maternity leave or any other such reason?", followed by the question "have you done any work in the last 12 months". Subsequently, to women who have worked during the last 12 months, the survey asked about the type of earnings for work: cash only; cash and in-kind; in kind only; or not paid. The answer categories are recoded into a binary: currently working or worked in the past year for payment (including cash and/or in kind) (coded 1); versus no work for payment (including those who worked for no payment and those who did not work) (coded 0).

Gender theories suggest a positive effect of women's participation in the labor market on women's power, leading to positive reproductive health behaviors and outcomes. A DHS analysis in 23 developing countries, including 13 from Africa, shows positive associations between women's employment and household-decision making, though the results are mixed with progressive gender norms (mostly positive or no association) (Kishor&Subaiya, 2008). Indeed, a substantial proportion of women were employed but not paid in cash or in-kind in either of these two countries, and particularly in Tanzania. Previous DHS studies on delivery care seeking or women's power examined employment (Woldemicael&Tenkorang, 2010; Woldemicael, 2010; Singh et al., 2011; Jayaraman, et al.

2008; Kishor&Subaiya, 2008), as compared to women's occupation given the differences in occupational options across study settings (e.g., availability and status of specific occupations). I anticipated positive effects of women's employment on women's power and SBA use.

(D) Household Wealth: MEASURE DHS constructed a household wealth index using household asset data and principal component analysis (NBS Tanzania&Macro, 2011). Household wealth is determined by ownership of consumer items and home attributes. Each asset was assigned a weight through principal component analysis. The resulting score of each asset is standardized, and then summed for each household. Households are ranked according to this total score, and then divided into quintiles from lowest to highest or one to five (e.g., poorest, poorer, middle, richer, or richest) (NBS Tanzania&Macro, 2011). This index has been used to interpret cross-/in-country comparisons of household wealth in the regular DHS report. I anticipated that the higher the household wealth level, the higher the level of women's power and the more likely women could use an SBA.

(E) Marital Relationship: The survey asked about respondent's marital relationship in a series of questions: "Are you currently married or living together with a man as if married?"; "Is your husband/partner living together with you now or staying elsewhere?"; "Does your

husband/partner have other wives or does he live with other women as if married?; "Including yourself, in total, how many wives or partners does your husband live with now as if married?"; "Are you the first, second,… wife?". A combined variable was created on marital relationship to examine the potential differences by the type of marital relationship and the differential status by wife order. The categories include: (1) married or in-union (that was phrased as living together with a man as if married in the survey) in a polygamous union as the first wife (coded 1); (2) married or union in a polygamy as the second or lower wife order (coded 2); (3) married or union in a monogamous union (coded 3). I anticipated that women in polygamous marriages as the second or lower wife order could have less power and be less likely to use an SBA compared to first wives and those in monogamous marriages.

(F) Household Headship: The respondents' relationship to the household head was asked: "What is the relationship of the respondent to the head of the household?" Answer options include head, wife, daughter, daughter-in-law, grand-daughter, mother, mother-in-law, sister, co-spouse, other relative, adopted/foster child, and not related. The variable was recoded to show if the respondent is a household head or not as a binary. It was anticipated that women who head the household would be more likely to be empowered and to use SBA than those who are not the head, thus more likely to use SBA. Women who are heads of household in this study population show variations with marital relationship though there is no clear

pattern (See sensitivity analysis section 2.9.2, Page 107). The dissertation analyses, as well as sensitivity analyses, show varied effects of household headship on SBA use, household decision-making power and progressive perceptions of gender norms (See sensitivity analysis section and main dissertation chapters). Therefore, I included the household head variable as a part of the sociodemographic characteristics; however, a final adjusted model without household headship was also tested (See sensitivity analysis section 2.9.4, Page 109).

(G) Gender Composition of Children: Data shows that son preference is widely prevalent in Africa and that son preference can also be a reflection of women's status and power (Fuse, 2008). The birth history record in the DHS collects information on the numbers and gender of children and their survival at the time of survey. The evidence and my work experience in the study settings imply that it matters if women deliver at least one son or not for the sake of family/kin inheritance. Thus, a variable was recoded to show if women have at least one living son or not as binary using the birth record. I anticipated that women who had at least one living son could have higher power and be more likely to use SBA.

(H) Place of Residence: Place of residence where the respondent was interviewed was categorized either as urban (coded 1) or rural (coded 2). The survey created this variable based on whether the respondent's cluster or sample point number was defined as urban or

rural. Urban areas include large cities and small cities (with population over 50,000) and towns (other areas identified as urban in the survey framework), while the rest is identified as rural. I anticipated that women in urban areas would be likely to have better access to health services financially and geographically and might espouse more progressive worldviews and norms that could facilitate progressive changes with family structure and relationship, as compared to those living in rural areas (Thornton&Fricke, 1987). Thus urban women would be likely to rank higher on the measures of women's power and to use an SBA as compared to rural women.

(I) Additional Variables for Sensitivity Analysis: Religion and ethnicity can be other important characteristics that influence women's power and delivery care use. These variables, however, were only collected in Senegal and not in Tanzania. In Senegal, the survey asked "What is your religion?" Answer options include "Muslim; Christian; Animist; No religion; and other". Because of the small proportion of respondents in the last three categories, the variable was recoded with the three categories as Muslim, Christian, and Other. The survey also asked "What is your ethnicity?" followed by the question asking "Are you Senegalaise?" The answers were recorded as "Wolof; Poular; Serer; Mandingue; Diola; Soninke; other; or Non-Senegalaise". The variable was recoded with the following categories after collapsing the minorities: Wolof; Poular, Serer; other ethnicities; and Non-Senegalaise.

To examine the influences of these variables on SBA use in Tanzania, a sub-analysis was conducted (See sensitivity analysis section 2.9.4, Page 109).

### 2.4.5. Control Variables Domain 2: Perceived Difficulty in Accessing Health Care

Perceived accessibility of health care has been identified as one of the determinants to women seeking delivery care (Thaddeus&Maine, 1994). Perceived accessibility of care in this analysis may also be referred to as a "rival independent variable", as its inclusion in the analysis allows the identification of any nonspurious influence on the focal dependent variable – that is, the unique influence of focal independent variable (e.g., education) on the focal dependent variable (e.g., SBA use) (Aneshensel, 2013).

The survey asked: "Many different factors can prevent women from getting medical advice or treatment for themselves. When you are sick and want to get medical advice or treatment, is each of the following a big problem or not? - 1) getting permission to go; 2) getting money needed for advice treatment; 3) the distance to the health facility; or 4) not wanting to go alone". The answer categories include: 1) big problem; 2) not a big problem; or 3) not a problem at all in Tanzania; 1) big problem or 2) not a big problem in Senegal. The variable was recoded for consistency between two countries as 1) big problem; or 2) not a big problem (including not a problem at all in Tanzania). The variables were summed to create a continuous variable by calculating the number of reasons about which a big problem was

perceived (scored 0-4), showing the higher number as perceiving more problems. A preliminary analysis showed that all the four measures of women's power are significantly and negatively related to perceived difficulty in accessing health care – that is, the higher the women's power, the less likely to perceive the difficulty (data not shown). I anticipated the higher the perceived difficulty, the less likely that women would be to use an SBA. A binary variable (i.e., perceive difficulty in one ore more aspects, or no perception of difficulty) was also tested, yet the conclusions did not change (data not shown).

## 2.5. Analytic Methods

### 2.5.1. Overview of Analysis

The data was entered into and managed by SAS program version 9.3. The analysis was conducted in six steps: univariate analysis (i.e., descriptive analysis); bivariate analysis; factor analysis; regression analysis; mediation analysis; and Structural Equation Modeling.

***Univariate and Bivariate Analyses***

The univariate analysis (i.e., descriptive analysis) and bivariate analysis (i.e., tests of overall association, and analyses of percent distribution or mean) were conducted mostly using SAS. In particular, the bivariate analyses were conducted 1) among key variables including the focal dependent and independent variables, and the mediators; and 2) among

indicators related to the individual mediators (i.e., three aspects of household decision-making; five situations of perceptions of gender norms against violence; and two aspects for sex negotiation). The bivariate associations between SBA use and each of the explanatory variables that were included in the regression model were also assessed using simple regression models (See Chapter Three, Table 3.3 and 3.4, Page 159-160).

***Factor Analyses***

Factor Analysis was conducted using Mplus version 7.11. First, the Exploratory Factor Analysis (EFA) was conducted to identify the underlying factor structure (i.e., latent constructs) of the ten indicators of women's power (See Factor Analysis section 2.8, Page 100). The EFA identifies the number of existing factors and their composition based on the Eigenvalues after conducting a geomin rotation, an oblique type of rotation that assumes the correlations among factors, and factor loadings of each indicator. The standard criterion for determining the appropriate number of factors is to include all factors with Eigenvalues (in the sample correlation matrix) greater than 1.0 (Pett, 2003). The EFA also examines the factor loading and statistical significance, which represent the extent to which the factor is reflected in the scores of that indicator, which examine convergent validity (i.e., high standardized loadings of indicators on factors, recommended to be >.30).

Confirmatory Factor Analysis (CFA) was then conducted to examine the appropriateness and generalizability of my factor model, as this is also a recommended preliminary step for SEM analysis using latent constructs (i.e., the measurement portion of SEM) (Kline, 2011; Bollen, 2011).

Factor analysis was conducted based on polychoric correlations that Mplus employs for categorical indicators. Model fit was assessed through the chi-square test of model fit for EFA; Root Mean Square Error of Approximation (RMSEA) (≤ 0.06 is a "close" fit) and CFI (Comparative Fit Index)/TLI (Tucker-Lewis Index) (≥ 0.95 or more as "close") for CFA, as well as Weighted Root Mean Square Residual (RMSR) (> 0.90) that Mplus estimates for the models with categorical indicators (Yu&Muthen, 2010).

According to the EFA and CFA results, the four dimensions of women's power were identified for the dissertation analysis – age at first marriage, household decision-making power, perceptions of gender norms against violence, and perceptions for sex negotiation (See Factor Analysis section 2.8, Page 100). In addition, the factor analysis indicates correlations between the factors that assess discriminant validity (i.e., not excessively high correlations between the factors, recommended to be < 0.85), as well as measurement error for each indicator (i.e., unique variance that is not explained by the factor but by the direct effects of all unmeasured sources).

### 2.5.2. Main Analysis – Regression, Mediation, and Structural Equation Modeling

For the main analysis under Aims 1 and 2, multivariate logistic regression and multiple linear regression analyses were conducted by SAS 9. 3. All analyses were adjusted for individual sample weight, strata, and Primary Sampling Unit (PSU). The elaboration model approach was applied. This is an explanatory model to determine if an empirical association between the focal independent and dependent variables potentially involves a causal connection (Rosenberg, 1968; Aneshensel, 2013). The model consists of two key strategies to establish internal validities (i.e., inference of cause and effect) – an exclusionary strategy to rule out alternative explanations, and an inclusive strategy to elaborate a causal system (Aneshensel, 2013). For mediation tests under Aim 2, Sobel tests were conducted using the interactive calculation tool by Preacher and Leonardelli (2013) for the test statistics, standard errors (SE), and p-value calculations; the confidence interval calculations were conducted with the RMediation package (Tofighi &MacKinnon, 2011).

Factor analysis and Structural Equation Modeling (SEM) analysis for Aim 3 were conducted using the Mplus version 7.11 to run the categorical outcome model considering survey weights. All analyses were also adjusted for individual sample weight, strata, and Primary Sampling Unit (PSU).

The standard error was corrected for clustering by woman and household for Aim 1 and 2 that examined birth as a unit of analysis, while SEM analysis was conducted using

woman as a unit of analysis (Aim 3). The variance inflation factor was assessed for all the explanatory variables included in the analysis and shown to be below cut-off point of 10, indicating that multicollinearity is minimal.

#### 2.5.2.1. Regression Analysis (Aim 1)

For Aim 1, the elaboration model approach was used to examine the focal relationship between women's education and SBA use, by ruling out spuriousness (i.e., confounding by sociodemographics) and redundancy (i.e., influence of "rival independent variable" – that is perceived difficulty in accessing health care – on the dependent variable) using an exclusionary strategy. Multivariate logistic regression analysis was conducted for categorical outcome variables, and multiple linear regression analysis for continuous outcome variables. Table 2.1 shows the statistical procedures and regression equations with the labels and notations for the equations of statistical models. Model fit was examined through Likelihood Ratio (LR) chi-square test and Wald chi-square test for logistic regression; and F-statistics, Root Mean Square Error (MSE), R-square and adjusted R-square for simple and multiple linear regression analysis. The coefficients, CI, and/or p-value are reported.

In accordance to the elaboration model approach, multivariate regression analysis was conducted according to the following steps: 1) Focal dependent variable (i.e., SBA use) was regressed on the focal independent (i.e. education) and the control variables (i.e.,

sociodemographic characteristics and perceived accessibility of health care); 2) mediators (i.e., age at first marriage, decision-making power, and perceptions of gender norms) were regressed on the focal independent and control variables; and 3) Focal dependent variable was regressed on the independent, mediators, and control variables and perceived accessibility of health care. Step 1 estimates the total effect of education on SBA use (from Model 1C); Step 2 estimates the effect of education on the mediators (from Model 2A-2D); and Step 3 estimates the effects of mediators on SBA use and the net direct effect of education on SBA use after accounting for its indirect effect through the mediators (from Model 3A-3D).

For example, Hypothesis 1.1 was tested by statistical modeling in steps using the exclusionary strategy (See Table 2.1). The first model (Model 1A) was a simple logistic regression model to test the association between education (i.e., the focal independent) and SBA use (i.e., the focal dependent). The second model (Model 1B) added the control variables from the domain of sociodemographic characteristics of women and households, to adjust for spuriousness (i.e., confounding). The third model (Model 1C) added another control variable – perceived difficulty in accessing health care – to adjust for redundancy. The results of statistical models under Aim 1 estimated the direct effects of independent variables on the outcome variable in the model.

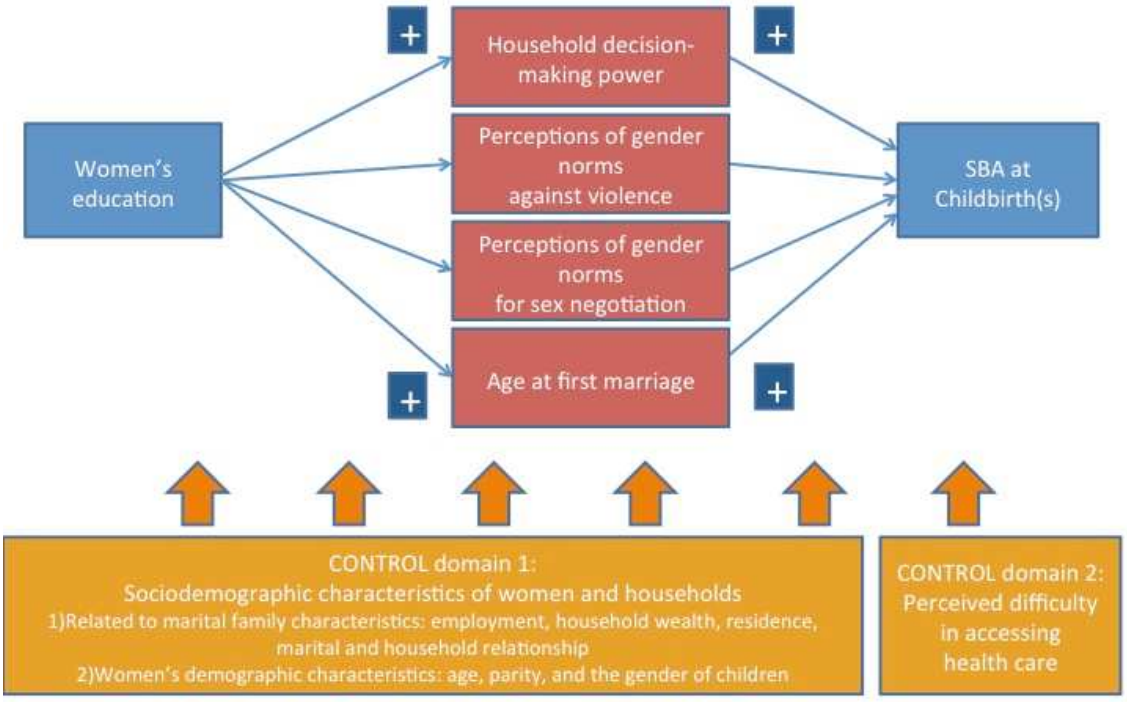
Table 2.1. Statistical Models for Regression Analysis for Aim 1

| ***AIM 1: Examine the association of women's status, age at first marriage, decision-making power, and perceptions of gender norms with SBA use in Senegal and Tanzania. [Regression analysis]*** | | |
|---|---|---|
| *Description of Statistical Procedure* | *Label* | *Regression Equation* |
| *Hypothesis 1.1:* Women's education is positively associated with SBA use, net of sociodemographic characteristics and perceived accessibility of health care. | | |
| Simple regression between education and SBA use | Model 1A | Y = a + bE |
| Adjustment for spuriousness by sociodemographics | Model 1B | Y = a + bE + bC1 |
| Adjustment for redundancy by perceived accessibility of health care | Model 1C | Y = a + bE + bC1 + bC2 |
| *Hypothesis 1.2:* Women's education is positively associated with age at first marriage, household decision-making power, and perceptions of gender norms, net of sociodemographic characteristics. | | |
| Age at first marriage regressed on education, adjusting for spuriousness by sociodemographics | Model 2A | A = a + bE + bC1 |
| Decision-making regressed on education, adjusting for spuriousness by sociodemographics | Model 2B | D = a + bE + bC1 |
| Perceptions of gender norms against violence regressed on education, adjusting for spuriousness by sociodemographics | Model 2C | V = a + bE + bC1 |
| Perceptions of gender norms for sex negotiation regressed on education, adjusting for spuriousness by sociodemographics | Model 2D | S = a + bE + bC1 |
| *Hypothesis 1.3:* Women's education, age at first marriage, household decision-making power, and perceptions of gender norms are positively associated with SBA use, net of sociodemographic characteristics and perceived accessibility of health care. | | |
| Add age at first marriage | Model 3A | Y= (Model 1C) + bA |
| Add decision-making | Model 3B | Y= (Model 1C) + bD |
| Add perceptions of gender norms against violence | Model 3C | Y= (Model 1C) + bV |
| Add perceptions of gender norms for sex negotiation | Model 3D | Y= (Model 1C) + bS |
| Add all these mediator variables | Model 3E | Y= (Model 1C)+ bD+bV+bS+ bA |

Note: Notations for the equations of statistical models[1]:
(1) Variables: Y = SBA use (dependent variable); E = education (independent variable);
A = Age at first marriage (mediator 1); D = decision-making power (mediator 2);
V = perceptions of gender norms against violence (mediator 3); S = perceptions for sex negotiation (mediator 4);
C1 = Sociodemographic characteristics of women and households (Control variables domain 1)
C2 = Perceived accessibility of health care (Control variables domain 2)
(2) Coefficients : a = regression intercept; b = unstandardized regression coefficient.

[1] It should be also noted that these variables are indicated in a generic term, while in practice, depending on the characteristics of variable included in the model, the variables and regression equations differ.

Figure 2.2. A Conceptual Framework for Aim 1 and 2




Although logistic regression is commonly used for binary outcomes, it should be noted that logistic regression entails several limitations that are affected by omitted variables. This problem is called "unobserved heterogeneity" – that is the variation in the dependent variable due to omitted variables (Mood, 2010). Coefficients are affected by omitted variables in logistic regression through different mechanism from that of OLS. In particular, logistic regression does not allow: 1) interpretation of substantive effects based on odds/odds ratios (OR); 2) comparing odds/OR across models with different independent variables; and 3) comparing odds/OR across samples, groups within samples, or over time (Mood, 2010). Therefore, in my regression analyses, I tested statistical significance and interpreted the odds

ratios from particular models, but did not statistically compare the magnitude of effects across models, groups, and samples. Also, in assessing moderation effects, I only tested the significance to examine if the effect of certain variables differs by group or not. Modifications to the estimates in logistic regression were considered but they would not improve the estimates for the specific models in my dissertation analysis (See Limitation section 6.3.2 in Discussion Chapter, Page 263).

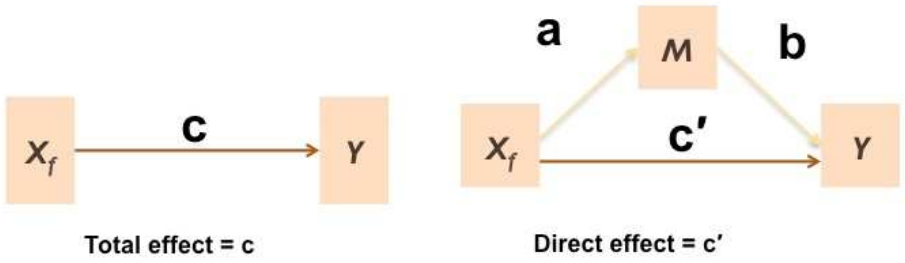
#### 2.5.2.2. Mediation Analysis (Aim 2)

In Aim 2 the potential causal connection of the focal relationship was examined using an inclusive strategy, by testing the mediation effects of household decision-making power, perceptions of gender norms, and age at first marriage on the focal relationship between education and SBA use (See Figure 2.2, Page 81).

Table 2.2. Statistical models for mediation analysis for Aim 2

| **AIM 2:** ***Examine the mediation effects of age at first marriage, decision-making power, and perceptions of gender norms on the relationship between education and SBA use in Tanzania and Senegal.*** | |
|---|---|
| *Hypothesis 2.4:* Age at first marriage, women's household decision-making power, and perceptions of gender norms mediate the relationship between education and SBA use in Senegal and Tanzania. | |
| *General procedures and notations* | *Equations* |
| Mediation analysis using Sobel tests, based on the MacKinnon's elaboration model. Coefficients are used from the previous models:<br><br>a = the effect of education on mediators (Coefficient of education from Model 2A-2D)<br><br>b = the effect of mediators on SBA use (Coefficients of each mediator from Model 3A-3E)<br><br>c = the total effect of education on SBA use (Coefficient of education from Model 1C)<br><br>c' = the net direct effect of education on SBA use (Coefficient of education from Model 3E) | Calculate the mediation effect using the MacKinnon's elaboration model as:<br><br>c-c'=ab<br><br>Size of the mediation effect is calculated as the proportion of the indirect effect relative to the direct effect as:<br><br>ab/c'<br><br>Sobel test based on these coefficients and SE. |

Figure 2.3: Diagrams for the concept of mediation analysis.




Source: CHS219 class slide by Dr. Aneshensel (2012)

For statistically testing and calculating the mediation effects, coefficients were derived from the statistical models that are nearly identical with those under Aim 1. As shown in Table 2.1 (Page 80), the effects of education on each mediator (expressed as "a") were derived from Model 2A-2D; the effects of each mediator on SBA use from Model 3A-3E (expressed as "b"); the total effect of education on SBA use from Model 1C (expressed as "c"); and the net direct effect of education on SBA use was estimated after accounting for its indirect effect through mediators and derived from Model 3A-3D (expressed as "c' - prime c").

The product of coefficient test (the multiplicative of "a" and "b") was conducted to assess mediation effects. The difference in coefficient test (i.e., "c" subtracted by "c' – prime c") was also considered. However, for mediation analysis of categorical dependent variable, the difference in coefficient test is not correct unless model parameters are standardized (i.e., rescaling the logistic regression coefficients using the variance of the underlying continuous latent variable) (MacKinnon, 2008). Thus, the product of coefficient test is more accurate and not susceptible to the scaling problem (i.e., OLS assessed the mean change in the outcome, while logistic regression assessed the log odds of the outcome) (MacKinnon, 2008). The size of the mediation effect was calculated as the mediation effect based on the product of coefficient test divided by the net direct effect.

Sobel tests were conducted to test for mediation effects with Sobel test statistics, Standard Error, and p value reported. The tests used the coefficients of the effects of education on age at first marriage, decision-making power, and perceptions of gender norms (expressed as "a"); the effects of these measures on SBA use (as "b"); and the standard errors of these coefficients. Given that Sobel tests assume a continuous outcome variable, caution is needed against the use for categorical outcome models. However, evidence suggests the relevance of these tests for categorical outcomes, especially when the sample size is large enough (MacKinnon et al., 2002). In the regression analysis, model fit was examined through the same test statistics as those for Aim 1.

#### 2.5.2.3. Structural Equation Modeling (SEM) (Aim 3)

SEM is useful in estimating and testing relationships between multiple constructs, and, as such, is useful for theory-testing (Weston&Gore, 2006). Different from the elaboration model approach using regression analysis, the SEM allows the examination of multiple mediators in sequence. By testing directions of multiple pathways among constructs through multiple equation models, SEM is a more rigorous method (as compared to regression analyses and elaboration model approaches) when testing potential causal mechanisms (Bollen&Noble, 2011; Kline, 2011). Another advantage is that SEM allows for the use of multiple measures to represent factors (i.e., latent constructs), which helps to reduce measurement error (Bollen&Noble, 2011; Kline, 2011).

In this study, SEM was used to examine the pathways from women's status to SBA use, through age at first marriage, household decision-making power and perceptions of gender norms, net of sociodemographic characteristics of women and households and perceived accessibility of health care. These analyses tested Hypothesis 3 – the relationship between education and SBA use is mediated by age at first marriage, and then household decision-making power and perceptions of gender norms.

The SEM for this study included two approaches: 1) a measured variable SEM (i.e., path analysis/model) that was comprised of all measured variables; and 2) a latent variable SEM that was comprised of a structural model (including all measured variable) and a measurement model (including latent variables/factors and indicators) (See Figures 2.4, 2.5). The application of the two modeling approaches demonstrated a comparative utility of these factors relative to that of the summative variables. The models analyzed five equations simultaneously, regressing SBA use, age at first marriage, household decision-making power, perceptions of gender norms against violence, and perceptions for sex negotiation. Probit regression analysis was employed, because it provides more efficient coefficient estimation than logistic regression analysis for a model with a categorical outcome in mediation analysis (MacKinnon, 2008). SEM models using probit regression assume that a latent continuous variable is hypothesized to underlie an observed ordinal/binary variable (Winship&Mare, 1983; Xie, 1989). Model fit was examined through Root Mean Square Error of

Approximation (RMSEA), Comparative Fit Index (CFI)/Tucker-Lewis Index (TLI), and Weighted Root Mean Square Residual (WRMR) using the aforementioned cut-off points.

Figure 2.4. A diagram for 1) the measured variable SEM (Same as Figure 2.1)

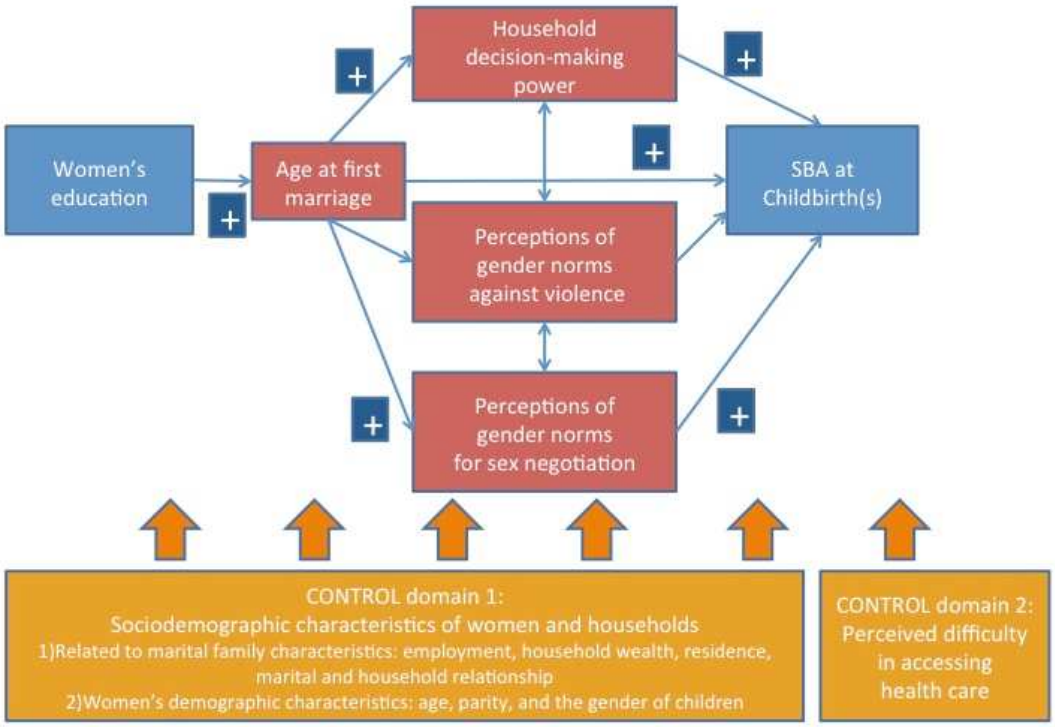
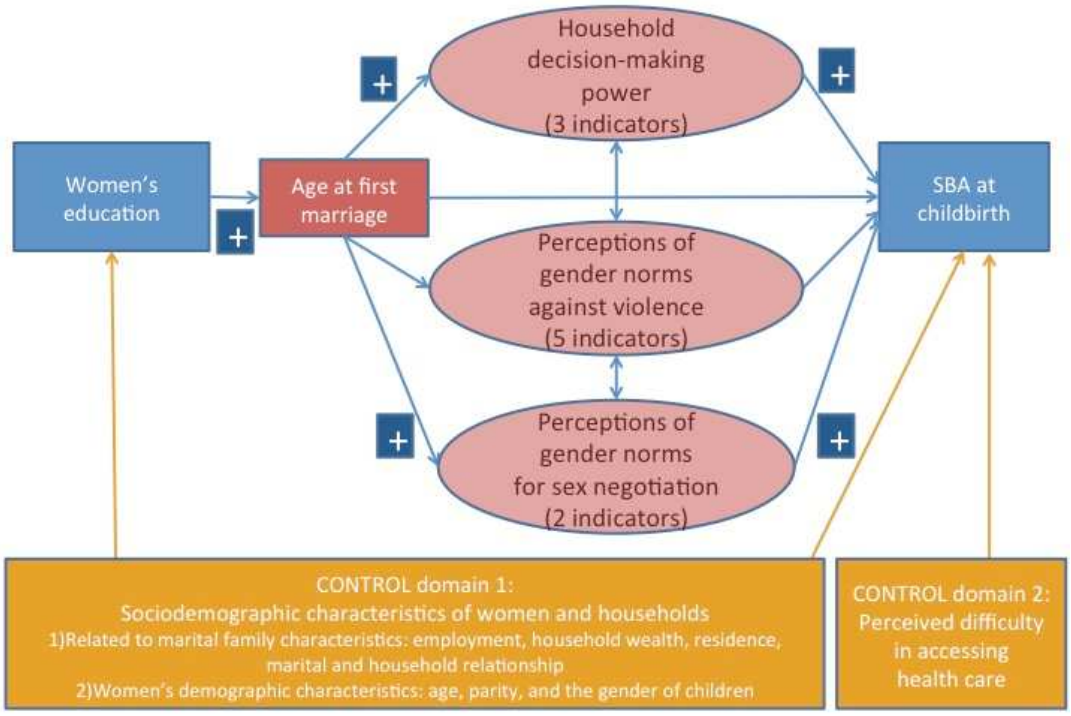


Figure 2.5. A diagram for 2) the latent variable SEM




In the diagrams, the ovals signify latent variables, and the boxes represent measured variables. These variables are classified either as endogenous (that appear as dependent variables in at least one equation) or exogenous variables (that are never dependent variables). In my models, exogenous variables are women's education and control variables – sociodemographic characteristics of women and households and perceived difficulty in accessing health care. All other variables are endogenous variables – SBA use, age at first marriage, household decision-making power, perceptions of gender norms against violence, and perceptions for sex negotiation. In the diagrams, single-headed arrows – also called paths – represent the direct effects, and these statistical estimates are path coefficients, which control for correlations among multiple presumed causes of the same variable. Double-

headed arrows signify correlations, and specifically the correlations of disturbances among latent variables that are estimated in the latent variable SEM. The errors/disturbances of decision-making power and perceptions of gender norms are covarying, as the unobserved aspects of these constructs are likely to be associated each other. Also, all of the exogenous variables related to socioeconomic status (i.e., education and sociodemographic characteristics of women and households) are designated as covarying, because each of the exogenous variables is likely to be related one another.

The estimated path coefficients can be interpreted as regression coefficients. For example, the unstandardized path coefficient of age at first marriage on household decision-making power indicates that a one-year increase in age at first marriage affects a certain point increase/decrease in the score of decision-making power. The standardized coefficients were also estimated to compare the magnitude of effects among variables with varied units.

In addition to the direct effects, indirect effects of variables through intervening variable(s) were estimated for each path that includes intervening variable(s). In building the models, I designated the independent and dependent variables of each equation in the model, and then calculated the mediation effects of all intervening paths. For example the effect of age at first marriage on SBA use is decomposed as 1) direct effect; and 2) indirect effects through household decision-making power and perceptions of gender norms, respectively. A statistically significant indirect effect through decision-making power indicates a significant

mediation effect of decision-making power. The total indirect effects were estimated as a sum of specific indirect effects through intervening variable(s) for each tested pathway. The total effect is the sum of the total indirect effect and the direct effect.

Alternative SEM models were also considered. Specifically, the models were respecified to consider potential reverse causalities and bi-directionalities between education and age at first marriage. In these re-specified models, however, this bi-directionality was not identified and the coefficients were not able to be estimated accordingly due to the fact that the parameters to be estimated exceeded the number of available degrees of freedom from the data. Another model was assessed that included a reversed pathway, such that age at first marriage influences women's education (age at first marriage → education), which in turn positively influences decision-making and perceptions of gender norms. The model fit statistics of this respecified model were similar to the originally specified SEM model (education → age at marriage), and the path coefficients were also similar, leading to nearly the same conclusions (data not shown). However, this reversed pathway was not supported by the descriptive analysis below, based on the mean years of education and age at first marriage. Therefore, the final SEM model that was informed by theory and the descriptive statistics was reported under Aim 3.

## 2.6. Descriptive Analysis

The descriptive results are shown in Table 2.3. Almost two thirds of the respondent used SBA at the last birth (66.3%) in Senegal (SN), while almost half (50.1%) in Tanzania (TZ). Almost half of the female study sample (3,657 in SN; 2,271 in TZ) had multiple births in the five years preceding the survey, with almost the same mean number of births in both settings (1.62 births) (Data not shown). The proportion of SBA use among all births (64.6% in SN; 47.5% in TZ) is slightly less (~2%) than the proportion of SBA use when only looking at the most recent birth.

Women's education, measures for women's power and sociodemographic characteristics also show some commonalities and variations between the two settings. In Tanzania most of the respondents attended primary education, and on average they attended school more than 5 years, yet in Senegal over two thirds (70.5%) did not have any formal education. On average women had low levels of household decision-making participation, especially in Senegal (Mean score 0.92 out of 3 in SN; 1.43 in TZ). Women perceive that gender violence is not justified to a similar degree in both countries (Mean 2.80 out of 5 in SN; 3.16 in TZ), although perceptions about sexual negotiations were much lower in Senegal (Mean 0.60 out of 2 in SN; 1.38 in TZ).

Women got married or started a union at similar and early ages in both countries (Mean 18.3 years in both), and started childbearing about a year later on average (Mean 19.1

years in SN; 19.7 in TZ) (data not shown here). In both countries, over half of women are below age 30, with the mean of 29.4 years in both at the time of interview. Almost two in five women were employed for payment or in the preceding 12 months in Tanzania, with a slightly higher proportion in Senegal (46.0% in SN; 38.1% in TZ). Women had delivered around 4 children (3.8 in SN; 3.9 in TZ). For two-thirds of the births, the index birth occurred for women who already had at least one living son (60.2% in SN; 62.3% in TZ). Polygamous union is more prevalent in Senegal than Tanzania; 68.2% of Senegalese women were in monogamous unions, as compared to 78.9% in Tanzania. Only 5% of women are heads of household in both settings (5.0% in SN; 5.7% in TZ). A greater proportion of women live in urban areas in Senegal as compared to Tanzania (40.0% in SN; 21.7% in TZ).

**Table 2.3. Characteristics of participating, currently married women with at least one birth in last 5 years (weighted n=7,033 in SN; n=4,445 in TZ), Senegal and Tanzania Demographic and Health Surveys (DHS) 2010**

| Variables | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Focal Dependent** | | | | | | |
| Skilled Birth Attendant (SBA) use at the last birth | 4,251 | 66.30 | 1.27 | 2,233 | 50.95 | 1.51 |
| **Focal Independent** | | | | | | |
| Education in years | | 1.79 | 0.08 | | 5.01 | 0.10 |
| No formal education | 5,577 | 70.54 | 1.21 | 1,082 | 24.42 | 1.22 |
| Primary attended | 1,384 | 20.74 | 1.01 | 2,771 | 68.93 | 1.18 |
| Secondary or above | 490 | 8.71 | 0.57 | 556 | 6.65 | 0.52 |
| **Women's power** | | | | | | |
| Household decision making power (scored 0-3) | | 0.92 | 0.03 | | 1.43 | 0.02 |
| Gender norms against violence (0-5) | | 2.80 | 0.05 | | 3.16 | 0.04 |
| Gender norms for sex negotiation (0-2) | | 0.60 | 0.02 | | 1.38 | 0.02 |
| Age at first marriage | | 18.29 | 0.10 | | 18.28 | 0.06 |
| **Demographics and perceived accessibility of health care** | | | | | | |
| Current age | | 29.40 | 0.12 | | 29.38 | 0.15 |
| Household wealth quintile | | | | | | |
| Poorest | 2,264 | 22.38 | 1.31 | 818 | 19.58 | 1.08 |
| Poorer | 1,882 | 20.95 | 1.18 | 957 | 22.61 | 0.96 |
| Middle | 1,534 | 19.19 | 1.13 | 905 | 21.47 | 0.92 |
| Richer | 1,056 | 19.85 | 1.34 | 954 | 19.99 | 1.12 |
| Richest | 715 | 17.63 | 1.12 | 775 | 16.35 | 1.14 |
| Employment for payment | | | | | | |
| Employed (currently or last 12 months) | 3,386 | 46.04 | 1.12 | 1,717 | 38.07 | 1.10 |
| Parity I (Total # of children ever born to women) | | 3.81 | 0.04 | | 3.90 | 0.05 |
| Marital relationships | | | | | | |
| Monogamous union | 4,909 | 68.19 | 0.83 | 3,394 | 78.87 | 0.53 |
| Polygamous as 1st wife | 991 | 12.73 | 0.44 | 434 | 8.97 | 0.53 |
| Polygamous as 2nd or lower | 1,550 | 19.08 | 0.55 | 549 | 12.16 | 0.82 |
| Household head | 322 | 4.98 | 0.38 | 251 | 5.67 | 0.47 |
| Place of residence | | | | | | |
| Urban | 2,267 | 39.95 | 1.62 | 878 | 21.67 | 1.18 |
| Rural | 5,184 | 60.05 | 1.62 | 3,531 | 78.33 | 1.18 |
| Perceived difficulty in accessing health care (Mean, scored 0-5) | | 1.23 | 0.04 | | 0.53 | 0.02 |

Note: Characteristics related to births were assessed including all births that women delivered in the last five years (weighted birth n=10,668 in SN; n=6,748 in TZ). The proportion of SBA use at the recent birth(s) was 64.6% in SN; 47.5% in TZ. The mean of birth order of each birth was 3.67 in SN; 3.75 in TZ. The proportion of births that took place when women had living son(s) was 60.2% in SN; 62.3% in TZ.

Frequency missing with demographic characteristics=32 (with marital relationships), and 17 (with perceived difficulty in accessing health care) in Tanzania; missing =1 (with marital relationship) in Senegal.

## 2.7. Bivariate Analysis

I first conducted overall association tests among the key variables including SBA use (focal dependent), education (focal independent), and proxies of women's power (potential mediators); and then the distributions of these variables were also assessed. The chi-square tests, one-way ANOVA, and simple logistic regression results show that the key variables are all significantly associated at $p<0.001$(Table 2.4, 2.5). The bivariate associations between SBA use and each of the exploratory variables were also assessed, and the unadjusted odds ratios from the simple (binary) logistic regression analyses, which do not account for control variables, show that most of the explanatory variables are significantly associated with SBA use (See Chapter Three, Table 3.3, 3.4). Exceptions are age at delivery and employment for payment in Senegal, and household headship in Tanzania. Moreover, individual indicators of women's power are significantly associated each other (Table 2.6, 2.7, 2.8, 2.9). The only exception was the association between perceptions of gender norms against violence when burning food and perceptions for asking condom use ($p=0.92$) in Tanzania.

**Table 2.4. Distribution of SBA use (as binary) by Women's Education and Power (weighted n=7,033 in Senegal; n=4,445 in Tanzania) and the Association Test Results, Senegal and Tanzania Demographic and Health Survey (DHS) 2010**

| | Percent/mean of women who used SBA | |
|---|---|---|
| | *Senegal* | *Tanzania* |
| Education *** | | |
| No formal education | 59.38 | 33.05 |
| Primary attended | 79.95 | 53.74 |
| Secondary or higher attended | 89.77 | 87.86 |
| Age at first marriage *** | 19.03 | 18.79 |
| Decision-making power *** | | |
| Score 0 | 62.01 | 43.00 |
| Score 1 | 67.93 | 49.76 |
| Score 2 | 70.61 | 56.20 |
| Score 3 | 75.11 | 57.53 |
| Perceptions of gender norms against violence *** | | |
| Yes (fully disapprove violence) | 79.61 | 58.00 |
| No | 58.83 | 45.84 |
| Perceptions of gender norms for sex negotiation *** | | |
| Yes (fully able to negotiate) | 77.21 | 56.81 |
| No | 63.94 | 43.49 |

Note: p<.001***, p<.01**, p<.05*

Using chi-square tests, "type3 analysis of effects" examined the overall association between two variables (i.e. how overall the variables are associated). And using simple logistic regression, "analysis of maximum likelihood estimates" examined the overall association using wald chi-square statistics.

With age at first marriage, mean is presented among women who used a SBA.

**Table 2.5. Distribution of Education by Women's Power (weighted n=7,033 in Senegal; n=4,445 in Tanzania) and the Association Test Results, Senegal and Tanzania Demographic and Health Survey (DHS) 2010**

| | Percent/mean of women with (1) no formal education | | (2) primary attended | | (3) secondary+ attended | |
|---|---|---|---|---|---|---|
| | *Senegal* | *Tanzania* | *SN* | *TZ* | *SN* | *TZ* |
| Age at first marriage*** | 17.47 | 17.30 | 19.71 | 18.38. | 21.53 | 20.89 |
| Decision-making power*** | | | | | | |
| Score 0 | 76.45 | 29.67 | 17.70 | 65.82 | 5.85 | 4.51 |
| Score 1 | 66.30 | 25.36 | 24.65 | 68.79 | 9.05 | 5.85 |
| Score 2 | 62.73 | 17.21 | 24.00 | 74.82 | 13.28 | 7.97 |
| Score 3 | 62.10 | 22.27 | 23.80 | 68.91 | 14.10 | 8.83 |
| Perceptions of gender norms against violence*** | | | | | | |
| Yes (fully disapprove violence) | 58.48 | 19.88 | 25.82 | 68.20 | 15.69 | 11.92 |
| No | 77.31 | 27.71 | 17.90 | 69.46 | 4.80 | 2.83 |
| Perceptions of gender norms for sex negotiation*** | | | | | | |
| Yes (fully able to negotiate) | 55.07 | 18.68 | 26.76 | 71.78 | 18.16 | 9.54 |
| No | 73.88 | 31.74 | 19.45 | 65.30 | 6.67 | 2.97 |

Note: p<.001***, p<.01**, p<.05*.
Using one-way ANOVA, F statistics are reported as an overall test. And using chi-square tests, "type3 analysis of effects" examined the overall association between two variables (i.e. how overall the variables are associated).
With age at first childbearing, means are presented by education level.

**Table 2.6. Bivariate distribution and overall association among decision-making indicators (weighted n=7,033 in Senegal)**

| | Percent of women who participated in decision with | | |
|---|---|---|---|
| | (1) health care | (2) purchase | (3) visit |
| Decision-making in own health care | - | | |
| No (not participate in decision-making) | | | |
| Yes (participate in decision-making) | | | |
| Decision-making in household purchase | <.0001*** | - | |
| No | 13.61 | | |
| Yes | 73.92 | | |
| Decision-making in visits to family/relatives | <.0001*** | <.0001*** | - |
| No | 9.01 | 7.32 | |
| Yes | 58.74 | 51.54 | |

Note: For the overall association tests, p-values for wald chi-square statistics are reported from the "analysis of maximum likelihood estimates" with p <.001***, p<.01**, p<.05*

**Table 2.7. Bivariate distribution and overall association among decision-making indicators (weighted n=4,445 in Tanzania)**

| | Percent of women who participated in decision with: | | |
|---|---|---|---|
| | (1) health care | (2) purchase | (3) visit |
| Decision-making in own health care | - | | |
| No (not participate in decision-making) | | | |
| Yes (participate in decision-making) | | | |
| Decision-making in household purchase | <.0001*** | - | |
| No | 42.02 | | |
| Yes | 87.69 | | |
| Decision-making in visits to family/relatives | <.0001*** | <.0001*** | - |
| No | 33.96 | 9.61 | |
| Yes | 85.41 | 65.44 | |

Note: For the overall association tests, p-values for wald chi-square statistics are reported from the "analysis of maximum likelihood estimates" with p <.001***, p<.01**, p<.05*

**Table 2.8. Bivariate distribution and overall association among perceptions of gender norms indicators (weighted n=7,033 in Senegal)**

| | Percent of women (A) who accept violence when: | | | | | (B) who can: | |
|---|---|---|---|---|---|---|---|
| | *(1) go out* | *(2) neglect* | *(3) argue* | *(4) refuse* | *(5) burn* | *(6) refuse* | *(7) ask* |
| ***Perceptions of gender norms against violence*** | | | | | | | |
| Go out without telling him | - | | | | | | |
| No (do not accept violence) | | | | | | | |
| Yes (accept violence) | | | | | | | |
| Neglect children | <.0001 *** | - | | | | | |
| No | 15.20 | | | | | | |
| Yes | 83.65 | | | | | | |
| Argue with him | <.0001 *** | <.0001 *** | - | | | | |
| No | 12.27 | 11.57 | | | | | |
| Yes | 80.12 | 78.58 | | | | | |
| Refuse to have sex | <.0001 *** | <.0001 *** | <.0001 *** | - | | | |
| No | 13.64 | 13.42 | 11.65 | | | | |
| Yes | 74.56 | 72.64 | 83.17 | | | | |
| Burn the food | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | - | | |
| No | 31.58 | 28.40 | 33.77 | 38.06 | | | |
| Yes | 83.32 | 87.66 | 90.66 | 91.56 | | | |
| ***Perceptions of gender norms for sex negotiation*** | | | | | | | |
| Refuse to have sex | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | - | |
| No (cannot refuse) | 48.94 | 47.67 | 52.50 | 56.81 | 30.22 | | |
| Yes (can refuse) | 38.19 | 37.43 | 41.88 | 43.00 | 20.72 | | |
| Ask using a condom | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | - |
| No (cannot ask) | 50.51 | 48.57 | 53.63 | 56.81 | 30.51 | 18.28 | |
| Yes (can ask) | 35.00 | 35.75 | 39.69 | 43.48 | 20.37 | 59.99 | |

Note: For the overall association tests, p-values for wald chi-square statistics are reported from the "analysis of maximum likelihood estimates" with p <.001***, p<.01**, p<.05*

**Table 2.9. Bivariate distribution and overall association among perceptions of gender norms indicators (weighted n=4,445 in Tanzania)**

| | Percent of women (A) who accept violence when: | | | | | (B) who can: | |
|---|---|---|---|---|---|---|---|
| | *(1) go out* | *(2) neglect* | *(3) argue* | *(4) refuse* | *(5) burn* | *(6) refuse* | *(7) ask* |
| ***Perceptions of gender norms against violence*** | | | | | | | |
| Go out without telling him | - | | | | | | |
| No (do not accept violence) | | | | | | | |
| Yes (accept violence) | | | | | | | |
| Neglect children | <.0001 *** | - | | | | | |
| No | 12.06 | | | | | | |
| Yes | 77.50 | | | | | | |
| Argue with him | <.0001 *** | <.0001 *** | - | | | | |
| No | 14.39 | 16.23 | | | | | |
| Yes | 77.54 | 82.82 | | | | | |
| Refuse to have sex | <.0001 *** | <.0001 *** | <.0001 *** | - | | | |
| No | 20.89 | 23.65 | 19.15 | | | | |
| Yes | 77.16 | 81.41 | 83.63 | | | | |
| Burn the food | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | - | | |
| No | 30.01 | 32.81 | 30.65 | 23.16 | | | |
| Yes | 85.08 | 90.34 | 88.58 | 86.63 | | | |
| ***Perceptions of gender norms for sex negotiation*** | | | | | | | |
| Refuse to have sex | <.0001 *** | <.0001 *** | <.0001 *** | <.0001 *** | 0.0332 * | - | |
| No (cannot refuse) | 49.98 | 53.60 | 50.99 | 48.95 | 22.70 | | |
| Yes (can refuse) | 37.63 | 40.80 | 38.93 | 30.84 | 19.23 | | |
| Ask using a condom | 0.0004 *** | 0.008** * | 0.0011 ** | <.0001 *** | 0.9212 | <.0001 *** | - |
| No (cannot ask) | 46.45 | 48.22 | 46.66 | 41.83 | 20.10 | 36.15 | |
| Yes (can ask) | 38.45 | 42.52 | 40.18 | 33.03 | 20.27 | 78.34 | |

Note: For the overall association tests, p-values for wald chi-square statistics are reported from the "analysis of maximum likelihood estimates" with p <.001***, p<.01**, p<.05*

## 2.8. Factor Analysis

Exploratory Factor Analysis (EFA) was conducted to identify the underlying factor structure (i.e., latent constructs) for the proxy indicators of women's power using Mplus 7.11. The analyses identified three factors in Senegal and Tanzania, based on the standard criterion of an Eigenvalue >1.0 in the sample correlation matrix. Confirmatory Factor Analysis (CFA) was also conducted to examine the appropriateness and generalizability of the identified factor structure.

The EFA was first conducted including age at first marriage; however, this had very low loadings (e.g., less than 0.2) on all of the identified factors, suggesting that this is a separate dimension from the others. The EFA results that include the identified three factors and respective indicators are presented (Table 2.10, 2.11). The tables show factor loadings of each of the three rotations based on geomin rotation – which is an oblique rotation that allows for correlations among factors and factor loadings of each indicator. In the tables, the CFA results of the identified three factor structure are also presented.

Model fit statistics show that the factor model (with three factors) fit the data well in both countries. The three factors are: 1) "***household decision-making power***" (to which three household decision-making participation indicators loaded highly, the loadings are >0.851 in SN and 0.795 in TZ); 2) "***perceptions of gender norms against violence***" (five indicators about the acceptance/justification of gender violence, the loadings are >0.822 in SN and

0.863 in TZ); and 3) "***perceptions of gender norms for sex negotiation***" (two indicators about the perceived ability to negotiate about sexual relations, the loadings are >0.771 in SN and 0.693 in TZ). Correlations between the three factors are all low (< 0.313 in SN and < 0.252 in TZ), suggesting that each factor is distinct and can have different influences on SBA use.

Furthermore, I checked the internal consistency of the summative measures based on the identified dimensions, finding high internal consistency for household decision-making (3 indicators) ($\alpha$ = 0.7767 SN; $\alpha$ = 0.7679 TZ); gender norms against violence (5 indicators) ($\alpha$ = 0.8721 SN; $\alpha$ = 0.8756 TZ); gender norms for sex negotiation (2 indicators) ($\alpha$ = 0.587 SN; $\alpha$ = 0.6062 TZ). The relatively lower alpha of the last dimension is likely to be due to the small number of indicators. The CFA results also demonstrated that the three factor models fit the data well. These model statistics with the three factor modes (in Table 13-14) are better than those with the two factor models (RMSEA=0.061 in SN and 0.080 in TZ; CFI=0.973 in SN and 0.958 in TZ; TLI=0.964 in SN and 0.944 in SN; WRMR=3.939 in SN and 3.956 in TZ) that comprise decision-making (3 indicators) and perceptions of gender norms (7 indicators). Therefore, the three factors used to operationalize women's power in the subsequent analyses were determined according to the EFA and CFA results.

**Table 2.10. Exploratory Factor Analysis and Confirmatory Factor Analysis for indicators of women's power (weighted n=7,033 in Senegal), Demographic and Health Survey (DHS) 2010**

| *Latent construct* | *Indicator* | *Aspects that survey asked* | *Factor loadings per iteration (EFA)* | | | *t-value (CFA)* |
|---|---|---|---|---|---|---|
| | | | *1* | *2* | *3* | |
| Household decision-making | Hlt | Decision on own health care | 0.916* | 0.007 | -0.016 | - |
| | Purc | Decision on major household purchases | 0.869* | 0.001 | 0.052 | 38.927* |
| | Visit | Decision on visits to family or relatives | 0.851* | -0.011 | -0.002 | 42.613* |
| Perceptions of gender norms against violence | Gout | Violence if going out without telling husband | -0.009 | 0.917* | 0.018 | - |
| | Negl | Violence if neglects the children | -0.025 | 0.933* | -0.003 | 101.880* |
| | Argue | Violence if argues with him | 0.044* | 0.963* | -0.030 | 122.107* |
| | Refs | Violence if refuses to have sex with him | 0.020 | 0.911* | 0.004 | 101.322* |
| | Burnf | Violence if burns the food | -0.022 | 0.822* | 0.022 | 63.985* |
| Gender norms for sex negotiation | negsex | Perceived ability in refusing sex | -0.020 | -0.017 | 0.803* | - |
| | negcon | Perceived ability in asking condom use | 0.045 | 0.016 | 0.771* | 8.305* |

Note:
Model fit statistics: [EFA for three factor model] RMSEA=0.034, CFI=0.996, TLI=0.989, SRMS=0.013; [CFA] RMSEA=0.016, CFI=0.998, TLI=0.997, WRMR=1.012. p<.05*.
Geomin factor correlations between: 1) decision-making and perceptions against violence 0.203*; 2) decision-making and perceptions for sex negotiation: 0.313*; 3) perception against violence and perceptions for sex negotiation: 0.260*.

**Table 2.11. Exploratory Factor Analysis and Confirmatory Factor Analysis for indicators of women's power (weighted n=4,445 in Tanzania), Demographic and Health Survey (DHS) 2010**

| *Latent construct* | *Indicator* | *Aspects that survey asked* | *Factor loadings per iteration (EFA)* | | | *t-value (CFA)* |
|---|---|---|---|---|---|---|
| | | | *1* | *2* | *3* | |
| Household decision-making | Hlt | Decision on own health care | 0.795* | -0.013 | 0.034 | - |
| | Purc | Decision on major household purchases | 0.865* | 0.010 | 0.006 | 32.303* |
| | Visit | Decision on visits to family or relatives | 0.939* | 0.006 | -0.029 | 32.267* |
| Gender norms against violence | Gout | Violence if going out without telling husband | 0.039 | 0.890* | 0.007 | - |
| | Negl | Violence if neglects the children | 0.028 | 0.922* | -0.014 | 87.206* |
| | Argue | Violence if argues with him | 0.016 | 0.929* | 0.007 | 87.299* |
| | Refs | Violence if refuses to have sex with him | -0.015 | 0.883* | -0.093* | 79.863* |
| | Burnf | Violence if burns the food | -0.014 | 0.863* | 0.098* | 56.115* |
| Gender norms for sex negotiation | negsex | Perceived ability in refusing sex | -0.006 | 0.101* | 0.844* | - |
| | negcon | Perceived ability in asking condom use | 0.102* | -0.012* | 0.693* | 8.006* |

Note:
Model fit statistics: [EFA for three factor model] RMSEA=0.036, CFI=0.996, TLI=0.989, SRMS=0.018; [CFA] RMSEA=0.028, CFI=0.995, TLI=0.993, WRMR=1.335. p<.05*.
Geomin factor correlations between 1) decision-making and perceptions against violence 0.243*; 2) decision-making and perceptions for sex negotiation: 0.252*; 3) perception against violence and perceptions for sex negotiation: 0.123*.

## 2.9. Preliminary and Sensitivity Analysis

### 2.9.1. Comparative Analysis of Married and Unmarried Women

Comparative univariate and bivariate analyses were conducted to assess if the sample characteristics are different between married women (included in analytic sample) and currently unmarried women (excluded from analytic sample), because the latter were not asked about questions related to women's power). The women that are excluded from the analysis are 979 in Tanzania and 539 in Senegal (weighted); and the unweighted women are 847 in Tanzania and 576 in Senegal. The births to these women are 1,263 in Tanzania and 660 in Senegal (weighted); the unweighted births are 1,089 in Tanzania and 715 in Senegal.

The descriptive statistics and the bivariate association test results are shown in Table 2.12 and 2.13. In general the characteristics of the analytic sample and the excluded sample are different from each other with respect to education, perceptions against gender violence, and marital status. Additionally, some sociodemographic characteristics differ greatly between the analytic and excluded samples and between the two countries. For example, currently unmarried women are much more likely to be at higher household wealth quintiles, higher education, and at younger age in Senegal. This may suggest that these women are at higher status and power. In Tanzania, the majority of currently unmarried women are ever marred, and are more likely to head households. These women may have elevated household decision-making power, or they may be isolated and disempowered. Thus the characteristics

of currently unmarried women are different from the general characteristics of the survey sample, and their exclusion may bias estimates in different directions. Impacts of these potential biases are found in Limitation section 6.3.2 in Discussion chapter (Page 263).

**Table 2.12. Descriptive analysis of currently married and unmarried women (weighted analytic women sample n=7,033; excluded sample n=539), Senegal Demographic and Health Surveys (DHS) 2010-2011**

| Variables | Married women (analytic sample) | | | Unmarried women (excluded sample) | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Outcome** | | | | | | |
| Skilled Birth Attendant (SBA) use at the last birth* | 4,251 | 66.30 | 1.27 | 409 | 78.90 | 1.80 |
| SBA use at the recent births (*1)* | 6,346 | 64.56 | 1.35 | 496 | 77.85 | 1.98 |
| **Women's power** | | | | | | |
| Participation in household decision making (scored 0-3) (N/A) | | 0.92 | 0.03 | | | |
| Gender norms against violence (0-5)* | | 2.80 | 0.05 | | 3.35 | 0.09 |
| Gender norms for sex negotiation (0-2) (N/A) | | 0.60 | 0.02 | | | |
| Age at first marriage (N/A) | | 19.29 | 0.10 | | 19.46 | 0.45 |
| **Demographics and perceived accessibility of health care** | | | | | | |
| Education* | | | | | | |
| No formal education | 5,577 | 70.54 | 1.21 | 258 | 43.60 | 2.83 |
| Primary attended | 1,384 | 20.74 | 1.01 | 170 | 31.83 | 2.72 |
| Secondary or above | 490 | 8.71 | 0.57 | 148 | 24.57 | 2.68 |
| Current age* | | 29.40 | 0.12 | | 26.38 | 0.39 |
| Household wealth quintile* | | | | | | |
| Poorest | 2,264 | 22.38 | 1.31 | 107 | 12.09 | 1.64 |
| Poorer | 1,882 | 20.95 | 1.18 | 142 | 18.93 | 1.95 |
| Middle | 1,534 | 19.19 | 1.13 | 166 | 24.10 | 2.24 |
| Richer | 1,056 | 19.85 | 1.34 | 103 | 21.98 | 3.23 |
| Richest | 715 | 17.63 | 1.12 | 58 | 22.89 | 3.46 |
| Employment for payment* | | | | | | |
| Employed (currently or last 12 months) | 3,386 | 46.04 | 1.12 | 317 | 47.48 | 3.02 |
| Parity I (Total # of children ever born to women)* | | 3.81 | 0.04 | | 2.14 | 0.10 |
| Parity II (Birth order of each birth) (*1)* | | 3.67 | 0.04 | | 2.18 | 0.11 |
| Marital relationships (N/A) | | | | | | |
| Monogamous union | 4,909 | 68.19 | 0.83 | | | |
| Polygamous as 1st wife | 991 | 12.73 | 0.44 | | | |
| Polygamous as 2nd or lower | 1,550 | 19.08 | 0.55 | | | |
| Household head (NS) | 322 | 4.98 | 0.38 | 28 | 5.06 | 1.31 |
| Place of residence* | | | | | | |
| Urban | 2,267 | 39.95 | 1.62 | 292 | 59.75 | 2.75 |
| Rural | 5,184 | 60.05 | 1.62 | 284 | 40.25 | 2.75 |
| Having son(s) at each delivery (*1)* | 7,043 | 60.23 | 0.65 | 245 | 32.33 | 2.99 |
| Perceived difficulty in accessing health care (Mean, scored 0-5) (NS) | | 1.23 | 0.04 | | 1.23 | 0.07 |

Note:
Excluded samples are women who gave birth(s) in the five years preceding the survey and not currently married.
Characteristics related to births (*1) are assessed including all births that women delivered in the last five years (weighted analytic sample birth n=10,668 in SN; excluded sample birth=715).
Frequency missing of excluded sample=10 (with perceptions against violence); 292 (with age at first marriage).
Statistical significance of the differences between analytic and excluded sample were tested using simple logistic regression (for binary variables), simple linear regression (for continuous variables), and chi-square tests (for categorical variables). p<.05 *. NS=Not significant. N/A=Not applicable.

**Table 2.13. Descriptive analysis of currently married and unmarried women (weighted analytic women sample n=4,445; excluded sample n=979), Tanzania Demographic and Health Surveys (DHS) 2010**

| Variables | Married women (analytic sample) | | | Unmarried women (excluded sample) | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted Mean or Proportion | SE | Freq | Weighted Mean or Proportion | SE |
| **Outcome** | | | | | | |
| Skilled Birth Attendant (SBA) use at the last birth* | 2,233 | 50.95 | 1.51 | 504 | 61.32 | 2.38 |
| SBA use at the recent births (*1)* | 3,198 | 47.51 | 1.55 | 615 | 57.43 | 2.35 |
| **Women's power** | | | | | | |
| Participation in household decision making (scored 0-3) (N/A) | | 1.43 | 0.02 | | | |
| Gender norms against violence (0-5)* | | 3.16 | 0.04 | | 3.37 | 0.07 |
| Gender norms for sex negotiation (0-2) (N/A) | | 1.38 | 0.02 | | | |
| Age at first marriage (N/A) | | 18.28 | 0.06 | | 18.29 | 0.18 |
| **Demographics and perceived accessibility of health care** | | | | | | |
| Education* | | | | | | |
| No formal education | 1,082 | 24.42 | 1.22 | 159 | 20.31 | 2.03 |
| Primary attended | 2,771 | 68.93 | 1.18 | 582 | 68.26 | 2.33 |
| Secondary or above | 556 | 6.65 | 0.52 | 106 | 11.44 | 1.58 |
| Current age* | | 29.38 | 0.15 | | 27.85 | 0.33 |
| Household wealth quintile (NS) | | | | | | |
| Poorest | 818 | 19.58 | 1.08 | 177 | 20.50 | 1.67 |
| Poorer | 957 | 22.61 | 0.96 | 183 | 20.37 | 1.88 |
| Middle | 905 | 21.47 | 0.92 | 160 | 20.49 | 1.94 |
| Richer | 954 | 19.99 | 1.12 | 185 | 20.49 | 1.72 |
| Richest | 775 | 16.35 | 1.14 | 142 | 18.15 | 1.76 |
| Employment for payment* | | | | | | |
| Employed (currently or last 12months) | 1,717 | 38.07 | 1.10 | 400 | 44.72 | 1.97 |
| Parity I (Total # of children ever born to women)* | | 3.90 | 0.05 | | 3.11 | 0.09 |
| Parity II (Birth order of each birth) (*1)* | | 3.75 | 0.05 | | 3.14 | 0.10 |
| Marital relationships (N/A) | | | | | | |
| Monogamous union | 3,394 | 78.87 | 0.53 | | | |
| Polygamous as 1st wife | 434 | 8.97 | 0.53 | | | |
| Polygamous as 2nd or lower | 549 | 12.16 | 0.82 | | | |
| Household head* | 251 | 5.67 | 0.47 | 263 | 31.94 | 1.97 |
| Place of residence* | | | | | | |
| Urban | 878 | 21.67 | 1.18 | 228 | 28.58 | 2.16 |
| Rural | 3,531 | 78.33 | 1.18 | 619 | 71.42 | 2.16 |
| Having son(s) at each delivery (*1)* | 4,203 | 62.28 | 0.83 | 536 | 50.47 | 1.95 |
| Perceived difficulty in accessing health care (Mean, scored 0-5) (NS) | | 0.53 | 0.02 | | 0.65 | 0.04 |

Note:
Excluded samples are women who gave birth(s) in the five years preceding the survey and not currently married.
Characteristics related to births (*1) are assessed including all births that women delivered in the last five years (weighted analytic sample birth n=6,748; excluded sample birth=1,089)
Frequency missing of analytic sample=32 (with marital relationships), and 17 (with perceived accessibility of health care). Frequency missing of excluded sample= 28 (with perceptions against violence); 7 (with perceived accessibility of health care); and 298 (with age at first marriage).
Statistical significance of the differences between analytic and excluded sample were tested using simple logistic regression (for binary variables), simple linear regression (for continuous variables), and chi-square tests (for categorical variables). $p<.05$ *. NS=Not significant. N/A=Not applicable.

### 2.9.2. Exploration of household headship

The characteristics of women who head households are also explored, because these women are likely to be different with respect to household decision-making. There is no clear pattern of the distribution of marital relationship (e.g., polygamous/monogamous, presence of husbands in the household) in terms of in both countries. The bivariate association results using chi-square tests suggest that marital relationships of female household heads versus non-household heads are significantly different in Tanzania, but not in Senegal (data not shown). Therefore household headship was included in the dissertation analysis as one of the predictors to examine its implication and influence on SBA use. To further explore the potential influence of household headship, its exclusion from the regression analysis was also tested, which did not change the conclusions (See sensitivity analysis section, 2.9.4, Page 109).

### 2.9.3. Regression Analysis on Women's Power

Multiple linear regression analysis on women's power was conducted, because the influence of sociodemographic characteristics of women and households on women's power is likely to be different across settings, leading to the disparate implication of women's power by setting. Under Aim 1, it was hypothesized that women's education is positively associated with age at first marriage, household decision-making power, and progressive perceptions of

gender norms, net of sociodemographic characteristics (Hypothesis 1.2). Under Aim 2, the effect of education (in single years as continuous variable) on power was also estimated, and the coefficients were used to calculate the mediation effects (See Chapter 4 Table 4.4).

In Model 1 (Column 1 of Tables 2.14 and 2.15), age at first marriage was regressed on education and other sociodemographic characteristics. Women's education is positively related to age at first marriage. Additionally, in both settings, women's age at the delivery is positively related to age at first marriage; and negatively polygamous union as 1$^{st}$ wife and having son(s).

In Model 2 (Colum 2 of Tables 2.14 and 2.15), household decision-making power was regressed on education and other control variables. In Senegal secondary or higher education is positively associated with decision-making, whereas in Tanzania the relationship between no education and decision-making shows a borderline significance. In both settings, women's age, employment for payment, and household heading are positively associated with decision-making power.

In Model 3 (Colum 3 of Tables 2.14, 2.15), perceptions of gender norms against violence were regressed. Relative to primary education, secondary or higher education is associated with increase in the predicted perceptions of gender norms against violence in both settings. Additionally, household wealth is positively related to the progressive perceptions in

both settings. Employment for payment was positively related in Tanzania, while negatively in Senegal.

In Model 4 (Colum 4 of Tables 2.14, 2.15), perceptions of gender norms for sex negotiation were regressed, and women's education is positively related to the progressive perceptions. Richest household wealth is positively related in both settings, and negatively polygamous as second or lower wife.

These OLS results highlight some similarities and variations by measure of women's power and by setting. In general, women's education is significantly and positively related to measures of power. Only a couple of sociodemographic variables (e.g., age) appear to influence each measure of power in a similar manner across settings. Overall the effect of sociodemographic characteristics shows variations by measure and by country, suggesting the contextual nature of women's power.

### 2.9.4. Exploration of Regression Analyses on Skilled Birth Attendant Use

Additional multivariate regression analyses were also conducted to explore the following aspects: 1) utility of each of individual indicators for women's power (Table 2.16); 2) utility of binary variables for women's power (Table 2.17); 3) influence of women's household headship (Table 2.18); and 3) influence of religion and ethnicity on SBA use (only in Senegal) (Table 2.19).

In the final adjusted multivariate logistic regression on SBA use (See Chapter Three Aim1, Table 3.3, 3.4, Model 3), all summative variables for women's power were replaced with each of the indicators for these variables. Despite the continued debate on the modality of operationalization of women's power, no identified studies tested and compared differences in operationalization (e.g., summative measures versus individual indicators).

The results show that only a couple of indicators are significantly associated with SBA use, which are likely to be the key driver among the concerned indicators comprising the summative measure (See Table 2.16). In Senegal, joint decision-making on own health care is associated with the higher odds of using SBA relative to no participation in this decision-making; and perceptions supporting for refusing sex. In Tanzania, joint decision-making on visits to family/relatives is related to the higher odds of using SBA relative to no participation; and perceptions supporting for asking condom use. Therefore, the model with summative measures suggests greater statistical power in estimating SBA use and is preferred to a model that includes each indicator.

Furthermore, the utility of binary variables for women's power was assessed (Table 2.17). Although there were some differences between these models and the final adjusted model with continuous variables, the overall conclusions were nearly the same (Model 3 under Aim 1), with a couple of exceptions that show a borderline significance.

In exploring the influence of household headship, the final adjusted model excluded household headship variable (Table 2.18). Indeed, in the final adjusted model (Model 3 under Aim 1), household headship was not significantly related to SBA use. This sensitivity analysis shows that the conclusions from the final model do not change, after excluding household headship variable (i.e., not accounting for household headship).

Last, the final adjusted multivariate logistic regression model on SBA use added religion and ethnicity only in Senegal due to their unavailability in Tanzania (Table 2.19). Religion is not significantly associated with SBA use; however, ethnicity is significantly associated with SBA use. Relative to Wolof women, Poular women and those of other minority ethnicities are less likely to use SBA (OR=0.568 and OR=0.605 respectively). Immigrant status (i.e., non-Senegalese) also showed a borderline significance (p=0.05). Even after controlling for these additional variables, the conclusions from the multivariate regression analysis results did not change. Age at first marriage, perceptions of gender norms against violence and for sex negotiation are positively associated with SBA use, while education and decision-making power are not significant predictors.

### 2.9.5. Influence of Husband's Characteristics

The final models are also adjusted additionally by husband's education and age, because these characteristics have a potential to influence women's power and/or delivery

care use. Husband's education in years and age are included in the fully adjusted regression models on SBA use (Table 2.20). Overall, the conclusions from the final model do not change after controlling for these husband's characteristics. Husband's education is significantly and positively related to SBA use in Tanzania (OR=1.055). This relationship is not significant in Senegal, yet the substantial number of missing (n=558) might have biased this estimate. Husband's age is not significantly related in either of these countries.

Additionally, women's relative education and age compared to their husbands were assessed (by subtracting their education in years and age). The conclusions were the same with those from the models including husband's absolute education and age, suggesting that husbands' higher education is related to higher odds of using SBA use (data not shown).

### 2.9.6. Partially Adjusted Mediation Analysis on Women's Power

Under Aim 2, there were some potential mediators that were not statistically significant ($p<0.05$), accounting for all other mediators. Thus the effect of each mediator was also assessed, without accounting for the other potential mediators, in order to examine the effect of each mediator separate from the other mediators (Table 2.21). In this sensitivity analysis, the fully adjusted multivariate model of SBA use included each of the mediators, but not other potential mediators (Model 3A-D in Table 2.1, Page 80), whereas in the fully

adjusted mediation analysis the fully adjusted multivariate model of SBA use included ALL of the mediators together (Model 3E in Table 2.1). In this analysis, the mediation effects that showed a borderline significance when accounting for other mediators have become statistically significant – perceptions of gender norms for sex negotiation in Tanzania and age at first marriage in Senegal.

### 2.9.7. Moderation Analysis

Moderation analysis was conducted to assess the conditional effect of women's status and power on SBA use. This additional analysis primarily focused on the influence of women's empowerment on SBA use, and moderation by sociodemographic variables was tested in order to examine the contextual nature of empowerment as related to SBA use. Specifically, the following moderation effects were tested: 1) the magnitude of effect of decision-making, perceptions of gender norms against violence, and perceptions for sex negotiation on SBA use differs by women's education; and 2) by early marriage (i.e., if women's first marriage was below age 18 or not).

(1) Moderation by education: In Tanzania, the magnitude of effect of decision-making and perceptions for sex negotiation on SBA use differs by women's education (Table 2.22). The

trend of these variations is disparate across measures. With decision-making, relative to women with primary education, the magnitude of this effect is larger among women with secondary or higher education and no education. Specifically, this difference of magnitude is much larger among women with secondary or higher education. On the other hand, the magnitude of effect of perceptions for sex negotiation is larger among women with no education compared to women with primary education, whereas there is no significant difference with this magnitude among women with primary and higher education. None of these moderation effects is significant in Senegal.

(2) Moderation by early marriage: Additionally, in Tanzania, the magnitude of effect of perceptions against violence on SBA use is larger among women whose first marriage was below age 18 (p=0.051) (Table 2.23). Yet other interaction terns do no show significance. In Senegal, none of the conditional effect of early marriage and power on SBA use is significant. In the model that includes age at first marriage and decision-making power (as continuous) instead of early marriage and full decision-making (as binary), the magnitude of effect of decision-making on SBA use is larger among women whose age at first marriage is younger at borderline significance (p=0.06) (data not shown).

**Table 2.14. Regression coefficients from multiple linear regression analyses of women's power (n=10,668 weighted), Senegal Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] Model 3 Age at first marriage | | | [Column 2] Model 4 Decision-making | | | [Column 3] Model 5 Against violence | | | [Column 4] Model 6 For sex negotiation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | b | SE | P | b | SE | P | b | SE | p | b | SE | p |
| **Focal independent** | | | | | | | | | | | | | |
| Highest education (Ref.=Primary education) | No education | -1.100 | 0.155 | *** | -0.070 | 0.052 | | -0.343 | 0.076 | *** | -0.187 | 0.034 | *** |
| | Secondary or above | 0.362 | 0.252 | | 0.197 | 0.092 | * | 0.352 | 0.116 | ** | 0.204 | 0.061 | *** |
| **Demographics** | | | | | | | | | | | | | |
| Age at the delivery | | 0.483 | 0.014 | *** | 0.010 | 0.003 | *** | 0.010 | 0.005 | * | -0.001 | 0.002 | |
| Household wealth (Ref.=Poorest) | Poorer | 0.448 | 0.110 | 0.07 | -0.114 | 0.039 | ** | 0.428 | 0.072 | *** | 0.011 | 0.026 | |
| | Middle | 0.950 | 0.139 | *** | 0.004 | 0.047 | | 0.579 | 0.086 | *** | 0.001 | 0.032 | |
| | Richer | 1.421 | 0.187 | *** | 0.070 | 0.064 | | 1.111 | 0.102 | *** | 0.037 | 0.043 | |
| | Richest | 1.468 | 0.207 | *** | 0.253 | 0.074 | *** | 1.309 | 0.119 | *** | 0.177 | 0.051 | *** |
| Parity | 1st birth | 5.445 | 0.190 | | -0.084 | 0.066 | | 0.065 | 0.102 | | 0.005 | 0.043 | |
| (Ref.=4th or more) | 2nd or 3rd birth | 3.881 | 0.142 | | -0.022 | 0.043 | | 0.111 | 0.068 | | 0.031 | 0.029 | |
| Employment for payment | (Ref.= Not employed) | -0.247 | 0.111 | * | 0.300 | 0.038 | *** | -0.112 | 0.058 | 0.052 | 0.043 | 0.025 | 0.08 |
| Household head | (Ref.= Not household head) | -0.445 | 0.305 | | 0.358 | 0.105 | *** | 0.095 | 0.138 | | -0.038 | 0.062 | |
| Urban residence | (Ref.=Rural) | 0.615 | 0.140 | | 0.166 | 0.048 | *** | 0.456 | 0.080 | *** | 0.124 | 0.032 | *** |
| Marital relationship | Polygamous as 1st wife | -1.416 | 0.166 | *** | -0.035 | 0.057 | | -0.186 | 0.085 | * | -0.008 | 0.037 | |
| (Ref.=Monogamous) | Polygamous as 2nd or lower | -0.214 | 0.143 | | 0.073 | 0.043 | 0.09 | -0.362 | 0.071 | *** | -0.065 | 0.028 | * |
| Having son(s) | | -0.598 | 0.121 | *** | 0.001 | 0.044 | | 0.026 | 0.069 | | -0.005 | 0.029 | |
| **Intercept** | | 3.302 | 0.413 | *** | 0.495 | 0.123 | *** | 1.967 | 0.190 | *** | 0.638 | 0.078 | *** |
| **Model statistics** | | | | | | | | | | | | | |
| R-square | | | | 0.4284 | | | 0.0739 | | | 0.15 | | | 0.0665 |
| Root MSE | | | | 3.4012 | | | 1.0951 | | | 1.8579 | | | 0.7361 |
| F statistic | | | | 155.96 | | | 16.75 | | | 61.87 | | | 15.02 |
| DF | | | | 15 | | | 15 | | | 15 | | | 15 |
| P | | | | *** | | | *** | | | *** | | | *** |

p<.001 ***, p<.01**, p<.05*

**Table 2.15. Regression coefficients from multiple linear regression analyses of women's power (n=6,748 weighted), Tanzania Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] Model 3 Age at first marriage | | | [Column 2] Model 4 Decision-making | | | [Column 3] Model 5 Against violence | | | [Column 4] Model 6 For sex negotiation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | b | SE | P | b | SE | P | B | SE | p | b | SE | p |
| **Focal independent** | | | | | | | | | | | | | |
| Highest education | No education | -0.750 | 0.128 | *** | -0.110 | 0.058 | 0.07 | -0.147 | 0.095 | | -0.261 | 0.040 | *** |
| (Ref.=Primary edu) | Secondary or above | 1.472 | 0.236 | *** | 0.055 | 0.087 | | 0.703 | 0.121 | *** | 0.221 | 0.044 | *** |
| **Demographics** | | | | | | | | | | | | | |
| Age at childbirth | | 0.298 | 0.013 | *** | 0.024 | 0.006 | *** | -0.002 | 0.008 | | -0.001 | 0.003 | |
| Household wealth (Ref.=Poorest) | Poorer | 0.261 | 0.168 | 0.09 | -0.011 | 0.072 | | 0.293 | 0.115 | ** | 0.058 | 0.047 | |
| | Middle | 0.208 | 0.150 | | -0.005 | 0.072 | | 0.035 | 0.121 | | 0.057 | 0.048 | |
| | Richer | 0.105 | 0.160 | | -0.135 | 0.076 | 0.08 | 0.205 | 0.124 | 0.099 | 0.062 | 0.051 | |
| | Richest | 0.565 | 0.256 | | 0.147 | 0.099 | | 0.985 | 0.167 | *** | 0.177 | 0.065 | *** |
| Parity | 1st birth | 3.640 | 0.205 | *** | 0.108 | 0.090 | | -0.192 | 0.138 | | -0.060 | 0.056 | |
| (Ref.=4th or more) | 2nd or 3rd birth | 2.549 | 0.142 | *** | 0.172 | 0.061 | ** | -0.074 | 0.096 | | 0.007 | 0.038 | |
| Employment for payment | (Ref.= Not employed) | -0.041 | 0.116 | | 0.162 | 0.050 | *** | 0.306 | 0.080 | *** | 0.074 | 0.033 | * |
| Household head | (Ref.= Not household head) | 0.294 | 0.335 | | 0.384 | 0.105 | *** | -0.081 | 0.166 | | 0.171 | 0.060 | ** |
| Urban residence | (Ref.=Rural) | 0.114 | 0.186 | | 0.065 | 0.071 | | -0.191 | 0.139 | | 0.001 | 0.050 | |
| Marital relationship | Polygamous as 1st wife | -0.787 | 0.194 | ** | -0.235 | 0.086 | ** | -0.102 | 0.126 | | -0.085 | 0.059 | |
| (Ref.=Monogamous) | Polygamous as 2nd or lower | 0.094 | 0.185 | | -0.375 | 0.080 | *** | -0.005 | 0.123 | | -0.139 | 0.052 | ** |
| Having son(s) | | -0.406 | 0.120 | ** | 0.059 | 0.059 | | 0.070 | 0.093 | | 0.031 | 0.038 | |
| **Intercept** | | 8.801 | 0.421 | *** | 0.626 | 0.170 | *** | 2.978 | 0.258 | *** | 1.395 | 0.109 | *** |
| **Model statistics** | | | | | | | | | | | | | |
| R-square | | | | 0.2512 | | | 0.0453 | | | 0.05165 | | | 0.05346 |
| Root MSE | | | | 2.7408 | | | 1.1794 | | | 1.8726 | | | 0.7633 |
| F statistic | | | | 53.93. | | | 10.58 | | | 21.04 | | | 14.75 |
| DF | | | | 15 | | | 15 | | | 15 | | | 15 |
| P | | | | *** | | | *** | | | *** | | | *** |

p<.001 ***, p<.01**, p<.05*

**Table 2.16. Odds Ratio from multivariate logistic regression analyses of skilled births attendants including each indicator of power (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** Model with all indicators of power | | | [Column 2] **Tanzania** | | |
|---|---|---|---|---|---|---|---|
| | | OR | CI | | OR | CI | |
| **Focal independent** | | | | | | | |
| Highest education (Ref.=Primary education) | No education | 0.969 | 0.807 | 1.162 | 0.722* | 0.592 | 0.882 |
| | Secondary or above | 0.935 | 0.615 | 1.422 | 1.431* | 1.043 | 1.962 |
| **Demographics** | | | | | | | |
| Age at childbirth | | 1.017* | 1.003 | 1.031 | 1.042* | 1.022 | 1.061 |
| Household wealth (Ref.=Poorest) | Poorer | 2.177* | 1.894 | 2.502 | 0.999 | 0.793 | 1.258 |
| | Middle | 4.276* | 3.608 | 5.067 | 1.512* | 1.2 | 1.903 |
| | Richer | 6.714* | 5.19 | 8.685 | 2.138* | 1.655 | 2.763 |
| | Richest | 16.212* | 11.114 | 23.65 | 5.744* | 3.821 | 8.634 |
| Parity (Ref.=4th or more) | First birth | 1.976* | 1.551 | 2.523 | 2.989* | 2.157 | 4.142 |
| | Second or third | 1.149 | 0.973 | 1.357 | 1.792* | 1.432 | 2.244 |
| Employment for payment | (Ref.= not employed) | 0.801* | 0.706 | 0.908 | 1.227* | 1.035 | 1.455 |
| Household head | (Ref.= not head) | 1.151 | 0.816 | 1.624 | 1.205 | 0.835 | 1.74 |
| Urban residence | (Ref.=Rural) | 2.894* | 2.407 | 3.479 | 2.228* | 1.628 | 3.048 |
| Marital relationship (Ref.=monogamous) | Polygamous as 1st wife | 0.819* | 0.68 | 0.986 | 0.573* | 0.436 | 0.752 |
| | 2nd or lower | 0.766* | 0.658 | 0.892 | 0.667* | 0.515 | 0.865 |
| Having son(s) | (Ref.=No living son) | 0.872 | 0.747 | 1.018 | 0.851 | 0.7 | 1.034 |
| **Other controls** | | | | | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.861* | 0.821 | 0.903 | 0.742* | 0.679 | 0.809 |
| **Women's power** | | | | | | | |
| **Age at first marriage** | | 1.028* | 1.011 | 1.045 | 1.021 | 0.993 | 1.05 |
| **Decision-making power** | | | | | | | |
| Own health care (Ref.=no participation) | Joint decision-making | 1.365* | 1.097 | 1.700 | 1.197 | 0.968 | 1.48 |
| | Own decision-making | 0.985 | 0.75 | 1.293 | 1.037 | 0.772 | 1.392 |
| Household purchases | Joint decision-making | 0.909 | 0.731 | 1.13 | 0.962 | 0.773 | 1.197 |
| | Own decision-making | 1.166 | 0.863 | 1.575 | 1.000 | 0.632 | 1.583 |
| Visits to family/relatives | Joint decision-making | 0.912 | 0.762 | 1.093 | 1.291* | 1.033 | 1.613 |
| | Own decision-making | 0.905 | 0.712 | 1.149 | 1.040 | 0.719 | 1.504 |
| **Perceptions of gender norms against violence** | | | | | | | |
| | Goes out | 1.201 | 0.998 | 1.445 | 0.900 | 0.717 | 1.13 |
| | Neglects the children | 1.039 | 0.863 | 1.252 | 0.968 | 0.77 | 1.217 |
| | Argues | 1.161 | 0.959 | 1.404 | 1.168 | 0.926 | 1.472 |
| | Refuses to have sex | 0.957 | 0.797 | 1.15 | 1.160 | 0.928 | 1.45 |
| | Burns the food | 1.120 | 0.962 | 1.305 | 0.905 | 0.712 | 1.151 |
| **Perceptions of gender norms for sex negotiation** | | | | | | | |
| | Refuse sex | 1.224* | 1.047 | 1.430 | 0.885 | 0.725 | 1.081 |
| | Ask using condom | 1.101 | 0.937 | 1.294 | 1.355* | 1.119 | 1.641 |
| **Intercept** | | -1.699 | | | -1.462 | | |
| **Model statistics:** | | | | | | | |
| **Logistic** | | | | | | | |
| LR (Chi-square) | | | | 3781.8414 | | | 1716.4326 |
| Wald (Chi-square) | | | | 1397.5300 | | | 767.6735 |
| DF | | | | 30 | | | 30 |
| P | | | | * | | | * |

p<.05*

**Table 2.17. Odds Ratio from multivariate logistic regression analyses of skilled birth attendants including binary measures of power (weighted n=10,668 in Senegal; n=6,748 in Tanzania), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** Model with binary measures of power | | | [Column 2] **Tanzania** | | |
|---|---|---|---|---|---|---|---|
| | | OR | CI | | OR | CI | |
| **Focal independent** | | | | | | | |
| Highest education (Ref.=Primary education) | No education | 0.926 | 0.772 | 1.111 | 0.695* | 0.57 | 0.849 |
| | Secondary or above | 0.941 | 0.618 | 1.434 | 1.415* | 1.038 | 1.928 |
| **Demographics** | | | | | | | |
| Age at childbirth | | 1.025* | 1.013 | 1.038 | 1.046* | 1.027 | 1.064 |
| Household wealth (Ref.=Poorest) | Poorer | 2.199* | 1.913 | 2.529 | 1.015 | 0.807 | 1.277 |
| | Middle | 4.329* | 3.651 | 5.133 | 1.54* | 1.224 | 1.939 |
| | Richer | 6.987* | 5.417 | 9.014 | 2.192* | 1.696 | 2.833 |
| | Richest | 16.282* | 11.151 | 23.772 | 5.875* | 3.92 | 8.806 |
| Parity (Ref.=4th or more) | First birth | 2.196* | 1.737 | 2.776 | 3.132* | 2.277 | 4.306 |
| | Second or third | 1.24* | 1.055 | 1.457 | 1.85* | 1.487 | 2.302 |
| Employment for payment | (Ref.= not employed) | 0.795* | 0.7 | 0.902 | 1.192* | 1.005 | 1.413 |
| Household head | (Ref.= not head) | 1.116 | 0.793 | 1.569 | 1.167 | 0.822 | 1.655 |
| Urban residence | (Ref.=Rural) | 2.962* | 2.467 | 3.556 | 2.224* | 1.628 | 3.038 |
| Marital relationship (Ref.=monogamous) | Polygamous as 1st wife | 0.798* | 0.663 | 0.961 | 0.548* | 0.42 | 0.715 |
| | 2nd or lower | 0.761* | 0.654 | 0.886 | 0.653* | 0.504 | 0.845 |
| Having son(s) | (Ref.=No living son) | 0.862 | 0.739 | 1.007 | 0.858 | 0.707 | 1.041 |
| **Other controls** | | | | | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.866* | 0.826 | 0.908 | 0.742* | 0.682 | 0.808 |
| **Binary measures for women's power** | | | | | | | |
| Early marriage (below age 18. Ref.=marriage at 18 or older) | | 0.915 | 0.802 | 1.045 | 0.97 | 0.825 | 1.141 |
| Decision-making power (summative scored 0-3) (all participation in decisions. Ref=not all participation) | | 1.182 | 0.988 | 1.414 | 1.262* | 1.056 | 1.508 |
| Perceptions of gender norms against violence (no gender violence acceptance. Ref.=some acceptance) | | 1.465* | 1.277 | 1.68 | 1.13 | 0.963 | 1.327 |
| Perceptions of gender norms for sex negotiation (complete ability for sex negotiation. Ref.=incomplete ability) | | 1.286* | 1.068 | 1.549 | 1.273* | 1.086 | 1.492 |
| **Intercept** | | -1.2749* (SE=0.2435) | | | -2.134* (SE=0.3206) | | |
| **Model statistics: Logistic** | | | | | | | |
| LR (Chi-square) | | 3745.4618 | | | 1677.9481 | | |
| Wald (Chi-square) | | 1328.0857 | | | 759.1475 | | |
| DF | | 20 | | | 20 | | |
| P | | * | | | * | | |

p<.05*

**Table 2.18. Odds Ratio from multivariate logistic regression analyses of skilled birth attendants excluding household headship (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** | | | [Column 2] **Tanzania** | | |
|---|---|---|---|---|---|---|---|
| | | OR | CI | | OR | CI | |
| **Focal independent** | | | | | | | |
| Highest education (Ref.=Primary education) | No education | 0.971 | 0.808 | 1.166 | 0.7* | 0.572 | 0.855 |
| | Secondary or above | 0.939 | 0.618 | 1.429 | 1.427* | 1.047 | 1.947 |
| **Demographics** | | | | | | | |
| Age at childbirth | | 1.018* | 1.004 | 1.032 | 1.04* | 1.021 | 1.06 |
| Household wealth (Ref.=Poorest) | Poorer | 2.189* | 1.905 | 2.514 | 1.007 | 0.801 | 1.266 |
| | Middle | 4.286* | 3.615 | 5.08 | 1.524* | 1.211 | 1.918 |
| | Richer | 6.76* | 5.237 | 8.726 | 2.16* | 1.674 | 2.788 |
| | Richest | 16.083* | 10.996 | 23.523 | 5.788* | 3.865 | 8.669 |
| Parity (Ref.=4th or more) | First birth | 1.997* | 1.569 | 2.542 | 2.933* | 2.118 | 4.06 |
| | Second or third | 1.155 | 0.979 | 1.363 | 1.776* | 1.421 | 2.221 |
| Employment for payment | (Ref.= not employed) | 0.798* | 0.703 | 0.905 | 1.199* | 1.011 | 1.422 |
| Urban residence | (Ref.=Rural) | 2.855* | 2.378 | 3.427 | 2.186* | 1.592 | 3.003 |
| Marital relationship (Ref.=monogamous) | Polygamous as 1st wife | 0.813* | 0.676 | 0.979 | 0.569* | 0.436 | 0.743 |
| | 2nd or lower | 0.762* | 0.655 | 0.887 | 0.69* | 0.541 | 0.879 |
| Having son(s) | (Ref.=No living son) | 0.867 | 0.743 | 1.012 | 0.852 | 0.702 | 1.035 |
| **Other controls** | | | | | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.865* | 0.825 | 0.907 | 0.739* | 0.678 | 0.805 |
| **Women's power** | | | | | | | |
| Age at first marriage | | 1.027* | 1.01 | 1.044 | 1.022 | 0.995 | 1.05 |
| Decision-making power (summative scored 0-3) | | 1.027 | 0.971 | 1.085 | 1.13* | 1.058 | 1.207 |
| Perceptions of gender norms against violence (0-5) | | 1.092* | 1.06 | 1.124 | 1.018 | 0.975 | 1.062 |
| Perceptions of gender norms for sex negotiation (0-2) | | 1.16* | 1.064 | 1.266 | 1.109* | 1 | 1.231 |
| **Intercept** | | -1.7154 | (SE=0.2216) | | -2.4816 | (SE=0.3393) | |
| **Model statistics: Logistic** | | | | | | | |
| LR (Chi-square) | | 3761.0718 | | | 1682.7095 | | |
| Wald (Chi-square) | | 1323.8432 | | | 755.1448 | | |
| DF | | 19 | | | 19 | | |
| P | | * | | | * | | |

p<.05*

**Table 2.19. Odds Ratio from multivariate logistic regression analysis of skilled birth attendants (n=10,668 weighted), Senegal Demographic and Health Survey (DHS) 2010-2011**

| Variables | | Senegal<br>Model including religion and ethnicity | | |
|---|---|---|---|---|
| | | OR | CI | |
| **Focal independent** | | | | |
| Highest education | No education | 0.930 | 0.771 | 1.122 |
| (Ref.=Primary education) | Secondary or above | 0.933 | 0.614 | 1.418 |
| **Demographics** | | | | |
| Age at childbirth | | 1.017* | 1.003 | 1.031 |
| Household wealth | Poorer | 2.012* | 1.747 | 2.316 |
| (Ref.=Poorest) | Middle | 3.799* | 3.194 | 4.519 |
| | Richer | 5.665* | 4.364 | 7.353 |
| | Richest | 13.104* | 8.917 | 19.259 |
| Parity | First birth | 2.003* | 1.573 | 2.55 |
| (Ref.=4th or more) | Second or third | 1.15 | 0.974 | 1.359 |
| Employment for payment | (Ref.= not employed) | 0.78* | 0.686 | 0.886 |
| Household head | (Ref.= not head) | 1.1 | 0.783 | 1.545 |
| Urban residence | (Ref.=Rural) | 3.175* | 2.638 | 3.819 |
| Marital relationship | Polygamous as 1st wife | 0.824* | 0.683 | 0.993 |
| (Ref.=monogamous) | 2nd or lower | 0.781* | 0.67 | 0.91 |
| Having son(s) | (Ref.=No living son) | 0.858 | 0.735 | 1.002 |
| **Other controls** | | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.871* | 0.83 | 0.913 |
| **Women's power** | | | | |
| Age at first marriage | | 1.02* | 1.003 | 1.037 |
| Decision-making power (summative scored 0-3) | | 1.029 | 0.973 | 1.089 |
| Perceptions of gender norms against violence (0-5) | | 1.092* | 1.06 | 1.125 |
| Perceptions of gender norms for sex negotiation (0-2) | | 1.162* | 1.064 | 1.268 |
| **Additional variables** | | | | |
| Religion (Ref.=Muslim) | Christian | 1.071 | 0.706 | 1.623 |
| | Other | 0.691 | 0.394 | 1.211 |
| Ethnicity (Ref.=Wolof) | Poular | 0.568* | 0.488 | 0.66 |
| | Serer | 0.898 | 0.734 | 1.1 |
| | Other ethnicity | 0.605* | 0.503 | 0.727 |
| | Non Senegalais | 0.792 | 0.604 | 1.04 |
| **Intercept** | | -1.215 (SE:0.2378) * | | |
| **Model statistics: Logistic** | | | | |
| LR (Chi-square) | | | | 3862.7555 |
| Wald (Chi-square) | | | | 1376.162 |
| DF | | | | 26 |
| P | | | | * |

p<.05*

**Table 2.20. Odds Ratio from multivariate logistic regression analyses of skilled birth attendants controlling for husband's characteristics (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** | | [Column 2] **Tanzania** | |
|---|---|---|---|---|---|
| | | OR | CI | OR | CI |
| **Focal independent** | | | | | |
| Education in years | | 1.012 | 0.979-1.045 | 1.044* | 1.01-1.074 |
| **Demographics** | | | | | |
| Age at childbirth | | 1.028* | 1.006-1.050 | 1.068* | 1.039-1.099 |
| Household wealth | Poorer | 2.22* | 1.924-2.561 | 0.997* | 0.79- 1.253 |
| (Ref.=Poorest) | Middle | 4.222* | 3.539-5.038 | 1.446* | 1.144-1.828 |
| | Richer | 7.181* | 5.473-9.421 | 1.972* | 1.524-2.551 |
| | Richest | 14.391* | 9.581-21.615 | 4.877* | 3.247-7.327 |
| Parity | | 0.93* | 0.879-0.984 | 0.795* | 0.737-0.857 |
| Employment for payment | (Ref.= not employed) | 0.804* | 0.706-0.917 | 1.158 | 0.975-1.374 |
| Household head | | 1.123 | 0.780-1.616 | 1.091 | 0.764-1.557 |
| Urban residence | (Ref.=Rural) | 2.847* | 2.344-3.457 | 2.11* | 1.544-2.882 |
| Marital relationship | Polygamous as 1st wife | 0.812* | 0.670-0.985 | 0.576* | 0.436-0.761 |
| (Ref.=monogamous) | 2nd or lower | 0.791* | 0.672-0.930 | 0.662* | 0.500-0.876 |
| Having son(s) | (Ref.=No living son) | 0.718* | 0.621-0.830 | 0.765 | 0.640-0.915 |
| **Other controls** | | | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.867* | 0.825-0.910 | 0.745* | 0.684-0.812 |
| **Women's power** | | | | | |
| Age at first marriage | | 1.018 | 0.997-1.039 | 0.995 | 0.964-1.026 |
| Decision-making power (summative scored 0-3) | | 1.013 | 0.956-1.073 | 1.118* | 1.046-1.195 |
| Perceptions of gender norms against violence (0-5) | | 1.091* | 1.058-1.125 | 1.013 | 0.971-1.058 |
| Perceptions of gender norms for sex negotiation (0-2) | | 1.169* | 1.066-1.281 | 1.098 | 0.989-1.219 |
| **Husband's characteristics** | | | | | |
| Husband's education (in years) | | 1.015 | 0.991-1.038 | 1.055* | 1.026-1.084 |
| Husband's age | | 0.996 | 0.990-1.002 | 1.003 | 0.991-1.014 |
| **Intercept** | | -1.1486* (SE=0.1783) | | -1.946* (SE=0.2987) | |
| **Model statistics: Logistic** | | | | | |
| LR (Chi-square) | | 3482.4884 | | 1698.8053 | |
| Wald (Chi-square) | | 1243.5864 | | 699.7767 | |
| DF | | 20 | | 20 | |
| P | | * | | * | |

p<.05*

**Table 2.21. Mediation test of women's power between education and skilled birth attendant use from partially adjusted models (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| **Key Coefficients**: | | | | | **Mediation Test Results**: | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Tanzania** | | **Senegal** | | | | | | |
| | b | SE | b | SE | Product of coefficient tests (a*b) | OR (=exponentiated ab) | Size of the mediation effect (ab/c') | Sobel test statistic | SE |
| ***1) The effect of education on mediators = a*** | | | | | | | | | |
| Age at first marriage = a(m) | 0.1337*** | 0.0162 | 0.1215*** | 0.0193 | A) Age at first marriage: | | | | |
| Decision-making power = a(d) | 0.0253** | 0.0076 | 0.0259*** | 0.0075 | Tanzania -0.0007 | 0.9993 | 1.14% | -0.3439 | 0.0021 |
| Gender norms against violence = a(v) | 0.0274* | 0.0125 | 0.0703*** | 0.0096 | Senegal 0.0026 | 1.0026 | 8.83% | 2.0283* | 0.0013 |
| Gender norms for sex negotiation = a(s) | 0.0398*** | 0.0051 | 0.0389*** | 0.0050 | B) Decision-making power: | | | | |
| ***2) The effect of mediator on SBA use = b*** | | | | | Tanzania 0.0032 | 1.0032 | 5.48% | 2.5086* | 0.0013 |
| Age at first marriage = b(m) | -0.0053 | 0.0154 | 0.0210* | 0.0098 | Senegal 0.0014 | 1.0014 | 4.43% | 1.6423 | 0.0008 |
| Decision-making power = b(d) | 0.1271*** | 0.0331 | 0.0524* | 0.028 | C) Perceptions against violence: | | | | |
| Perceptions against violence = b(v) | 0.0285 | 0.0215 | 0.0904*** | 0.0152 | Tanzania 0.0008 | 1.0008 | 1.28% | 1.1352 | 0.0007 |
| Perceptions for sex negotiation = b(s) | 0.1241* | 0.0524 | 0.1638*** | 0.043 | Senegal 0.0064 | 1.0064 | 26.59% | 4.6147*** | 0.0014 |
| ***3) The total effect of education on SBA use = c*** | | | | | D) Perceptions for sex negotiation: | | | | |
| | 0.0616*** | 0.0135 | 0.0316*** | 0.015 | Tanzania 0.0049 | 1.0050 | 8.67% | 2.2678* | 0.0022 |
| ***4) The net direct effect of education on SBA use = c'*** *(that is derived from the regression models including each of the potential mediators)* | | | | | Senegal 0.0064 | 1.0064 | 24.43% | 3.4254*** | 0.0019 |
| Age at first marriage = c'(m) | 0.0622*** | 0.0138 | 0.0289 | 0.015 | | | | | |
| Decision-making power = c'(d) | 0.0587*** | 0.0135 | 0.0306 | 0.015 | | | | | |
| Perceptions against violence = c'(v) | 0.0611*** | 0.0135 | 0.0239 | 0.015 | | | | | |
| Perceptions for sex negotiation = c'(s) | 0.0570*** | 0.0135 | 0.0261 | 0.015 | | | | | |

Note: p<0.05*, p<0.01**, p<0.001***

Mediation effects of each potential mediator were assessed separately, without accounting for the other potential mediators.

**Table 2.22. Odds Ratio from multivariate logistic regression analyses of skilled birth attendants including interaction terms of women's education and power (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** | [Column 2] **Tanzania** |
|---|---|---|---|
| | | OR | OR |
| **Focal independent** | | | |
| Highest education | No education | 0.956 | 0.535* |
| (Ref.=Primary Education) | Secondary or above | 1.387 | 1.030 |
| **Demographics** | | | |
| Age at childbirth | | 1.026* | 1.046* |
| Household wealth | Poorer | 2.197* | 1.018* |
| (Ref.=Poorest) | Middle | 4.319* | 1.538* |
| | Richer | 7.004* | 2.197* |
| | Richest | 16.731* | 5.798* |
| Parity | First birth | 2.226* | 3.117* |
| (Ref.=4th or more) | Second or third | 1.255* | 1.846* |
| Employment for payment | (Ref.= not employed) | 0.794* | 1.189* |
| Household head | | 1.115 | 1.171 |
| Urban residence | (Ref.=Rural) | 2.96* | 2.249 |
| Marital relationship | Polygamous as 1st wife | 0.797* | 0.547* |
| (Ref.=monogamous) | 2nd or lower | 0.758* | 0.659* |
| Having son(s) | (Ref.=No living son) | 0.863† | 0.858 |
| **Other controls** | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.866* | 0.743* |
| **Women's power (binary measures)** | | | |
| Early marriage | | 0.918 | 0.965 |
| Full decision-making power | | 1.100 | 1.119 |
| No acceptance of gender-violence | | 1.645 | 1.184† |
| Complete ability for sex negotiation | | 1.353 | 1.121 |
| **Interaction terms** | | | |
| Full decision-making×No education | | 1.089 | 1.468† |
| Full decision-making×Secondary or higher | | 1.071 | 1.973* |
| No acceptance of gender-violence×No education | | 1.887 | 0.811 |
| No acceptance of gender-violence×Sec or higher | | 0.658 | 0.949 |
| Complete ability for sex negotiation×No education | | 1.004 | 1.587* |
| Complete ability for sex negotiation×Sec or higher | | 0.457 | 1.299 |
| **Intercept** | | -1.343* (SE=0.2523) | -2.040* (SE=0.3221) |
| **Model statistics: Logistic** | | | |
| LR (Chi-square) | | 3756.0402 | 1702.9985 |
| Wald (Chi-square) | | 1383.2781 | 788.8081 |
| DF | | 26 | 26 |
| P | | * | * |

p<.05*, † = p<0.10.

**Table 2.23. Odds Ratio from multivariate logistic regression analyses of skilled birth attendants including interaction terms of early marriage and power (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Variables | | [Column 1] **Senegal** | [Column 2] **Tanzania** |
|---|---|---|---|
| | | OR | OR |
| **Focal independent** | | | |
| Highest education | No education | 0.926 | 0.695* |
| (Ref.=Primary Education) | Secondary or above | 0.944 | 1.463* |
| **Demographics** | | | |
| Age at childbirth | | 1.025* | 1.046* |
| Household wealth | Poorer | 2.198* | 1.012* |
| (Ref.=Poorest) | Middle | 4.325* | 1.535* |
| | Richer | 6.998* | 2.195* |
| | Richest | 16.304* | 5.887* |
| Parity | First birth | 2.192* | 3.137* |
| (Ref.=4$^{th}$ or more) | Second or third | 1.24* | 1.845* |
| Employment for payment | (Ref.= not employed) | 0.795* | 1.192* |
| Household head | | 1.12 | 1.177 |
| Urban residence | (Ref.=Rural) | 2.967* | 2.273* |
| Marital relationship | Polygamous as 1st wife | 0.799* | 0.546* |
| (Ref.=monogamous) | 2nd or lower | 0.76* | 0.657* |
| Having son(s) | (Ref.=No living son) | 0.861† | 0.859 |
| **Other controls** | | | |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.866* | 0.74* |
| **Women's power (binary measures)** | | | |
| Early marriage | | 0.885 | 0.785† |
| Full decision-making power | | 1.083 | 1.368* |
| No acceptance of gender-violence | | 1.434* | 0.965 |
| Complete ability for sex negotiation | | 1.286† | 1.126 |
| **Interaction terms** | | | |
| Full decision-making×early marriage | | 1.170 | 0.837 |
| No acceptance of gender-violence×early marriage | | 1.041 | 1.371† |
| Complete ability for sex negotiation×early marriage | | 1.007 | 1.280 |
| **Intercept** | | -1.251* (SE=0.2455) | -2.025* (SE=0.3233) |
| **Model statistics: Logistic** | | | |
| LR (Chi-square) | | 3746.8504 | 1691.4890 |
| Wald (Chi-square) | | 1343.1390 | 760.9553 |
| DF | | 23 | 23 |
| P | | * | * |

p<.05*, † = p<0.10.

**Appendix 2.1. The track of the exclusion of women and corresponding births from the dataset, Demographic and Health Surveys in Senegal and Tanzania, 2010**

| *Procedures of exclusions* | *Senegal DHS 2010-2011* | | *Tanzania DHS 2010* | | *Note* |
|---|---|---|---|---|---|
| | *Unweighted* | *(excluded)* | *Unweighted* | *(excluded)* | |
| Women survey sample | 15,688 | | 10,139 | | |
| Women who delivered at least once in the last five years preceding the survey | 8,146 | 7,542 | 5,349 | 4,790 | *1 |
| Married women who delivered at least once in the last five years | 7,570 | 576 | 4,502 | 847 | *2 |
| Married women who delivered at least once in the last five years and responded to all decision-making questions | 7,570 | 0 | 4,491 | 11 | *3 |
| Married women who delivered at least once in the last five years and responded to gender norm questions | 7,451 | 119 | 4,409 | 82 | *4 |
| **The total women in the study sample** | **7,451 (unweighted)** | **7,033 (weighted)** | **4,409 (unweighted)** | **4,445 (weighted)** | |
| **The total births to the women in the study sample** | **11,431 (unweighted)** | **10,668 (weighted)** | **6,756 (unweighted)** | **6,748 (weighted)** | *5 |

Note:
*1 Observations which are missing in the outcome variable (=4,790 in TZ; =7,542 in SN) were excluded.
*2 Observations which are not married and not asked about decision-making questions were excluded (frequency missing=847 in TZ; =576 in SN).
*3 Observations which are missing in decision-making questions (health care=1; household purchase=3; visits to friends and relatives=9; in total 11 observations) were excluded (TZ).
*4 Observations which are missing in gender norms questions (=82 in TZ; =119 in SN) were excluded.
*5 The total number of birth in the survey was 8,023 in Tanzania and 12,326 in Senegal.

**Appendix 2.2. Descriptive analysis of the original variables for education and the perceived difficulty in accessing health care variables (n=7,033 weighted and n=7,451 unweighted in Senegal; n=4,445 weighted and n=4,409 unweighted in Tanzania), Senegal and Tanzania Demographic and Health Survey (DHS) 2010**

| Variables | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Focal independent variable – highest education attended** | | | | | | |
| No education | 5,577 | 70.54 | 1.21 | 1,082 | 24.42 | 1.22 |
| Primary attended | 1,384 | 20.7442 | 1.01 | 2,771 | 68.93 | 1.18 |
| Secondary attended | 459 | 7.69 | 0.53 | 543 | 6.36 | 0.51 |
| Higher attended | 31 | 1.03 | 0.22 | 13 | 0.29 | 0.14 |
| **Perceived difficulty in accessing Health Care** | | | | | | |
| Getting permission to go | | | | | | |
| Not a problem at all | - | - | - | 4,051 | 91.36 | 0.55 |
| Big problem | 1,284 | 17.53 | 1.18 | 116 | 2.97 | 0.35 |
| Not a big problem | 6,167 | 82.47 | 1.18 | 238 | 5.67 | 0.43 |
| Getting money needed for advice treatment | | | | | | |
| Not a problem at all | - | - | - | 2,533 | 56.47 | 1.13 |
| Big problem | 4,172 | 54.19 | 1.06 | 941 | 23.15 | 1.01 |
| Not a big problem | 3,279 | 45.81 | 1.06 | 931 | 20.38 | 0.80 |
| The distance to the health facility | | | | | | |
| Not a problem at all | - | - | - | 2,646 | 56.05 | 1.64 |
| Big problem | 3,087 | 35.69 | 1.58 | 918 | 22.78 | 1.37 |
| Not a big problem | 4,364 | 64.31 | 1.58 | 833 | 21.16 | 0.97 |
| Not wanting to go alone | | | | | | |
| Not a problem at all | - | - | - | 3,204 | 70.53 | 1.05 |
| Big problem | 1,397 | 15.89 | 0.89 | 504 | 12.00 | 0.71 |
| Not a big problem | 6,054 | 84.11 | 0.89 | 692 | 17.47 | 0.77 |

**Appendix 2.3. Descriptive analysis of the original and recoded variables for decision-making and early marriage (women n=7,033 weighted and n=7,451 unweighted in Senegal; n=4,445 weighted and n=4,409 unweighted in Tanzania), Senegal and Tanzania Demographic and Health Survey (DHS) 2010**

| Variables | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Decision-making power** | | | | | | |
| Women's participation in household decision-making on 3 items (scored 0-3) | | 0.92 | 0.03 | | 1.43 | 0.02 |
| Score 0 (no participation) | 4,208 | 53.02 | 1.45 | 1,529 | 32.41 | 0.91 |
| 1 | 1,292 | 17.97 | 0.84 | 919 | 20.99 | 0.84 |
| 2 | 874 | 12.88 | 0.77 | 764 | 17.73 | 0.77 |
| 3 | 1,077 | 16.14 | 0.86 | 1,197 | 28.86 | 0.86 |
| Decision-making participation in all | 1,077 | 16.14 | 0.86 | 1,197 | 28.86 | 0.86 |
| Not all participation | 6,374 | 83.86 | 0.86 | 3,212 | 71.14 | 0.86 |
| Participation in decision-making on own health care | | | | | | |
| No participation | 5,559 | 71.55 | 1.22 | 1,915 | 41.35 | 0.98 |
| Joint decision-making | 1,288 | 18.03 | 1.05 | 1,783 | 44.29 | 0.96 |
| Own decision-making | 604 | 10.42 | 0.67 | 711 | 14.35 | 0.66 |
| Participation in decision-making on household purchases | | | | | | |
| No participation | 5,758 | 75.40 | 0.97 | 2,936 | 63.59 | 0.92 |
| Joint decision-making | 1,303 | 18.33 | 0.99 | 1,246 | 30.94 | 0.93 |
| Own decision-making | 390 | 6.27 | 0.43 | 227 | 5.46 | 0.42 |
| Participation in decision-making on visits to family or relatives | | | | | | |
| No participation | 4,765 | 60.92 | 1.44 | 2,338 | 52.01 | 0.99 |
| Joint decision-making | 1,898 | 26.34 | 1.34 | 1,703 | 39.84 | 1.03 |
| Own decision-making | 788 | 12.75 | 1.04 | 368 | 8.15 | 0.57 |
| **Age at first marriage** | | | | | | |
| Age at first marriage | | 19.29 | 0.10 | | 18.28 | 0.06 |
| Below age 18 (early marriage) | 4,067 | 49.18 | 0.90 | 2,000 | 45.93 | 1.08 |
| At age 18 or over | 3,384 | 50.82 | 0.90 | 2,409 | 54.07 | 1.08 |

**Appendix 2.4. Descriptive analysis of the original and recoded variables for perceptions of gender norms (women n=7,033 weighted and n=7,451 unweighted in Senegal; n=4,445 weighted and n=4,409 unweighted in Tanzania), Senegal and Tanzania Demographic and Health Survey (DHS) 2010**

| Variables | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Perceptions of gender norms against violence** | | | | | | |
| Disapprove gender violence in all situations | 2213 | 35.93 | 1.14 | 2145 | 42.05 | 1.10 |
| Do not completely disapprove | 5238 | 64.07 | 1.14 | 2264 | 57.95 | 1.10 |
| Gender violence is not justified when wife goes out without telling husband | | | | | | |
| Yes (disapprove gender violence) | 3,529 | 54.24 | 1.12 | 2,764 | 58.86 | 1.02 |
| No (approve gender violence) | 3,922 | 45.76 | 1.12 | 1,645 | 41.14 | 1.02 |
| Gender violence is not justified when wife neglects the children | | | | | | |
| Yes (disapprove gender violence) | 3,619 | 55.36 | 1.13 | 2,685 | 55.56 | 1.02 |
| No (approve gender violence) | 3,832 | 44.64 | 1.13 | 1,724 | 44.44 | 1.02 |
| Gender violence is not justified when wife argues with husband | | | | | | |
| Yes (disapprove gender violence) | 3,321 | 50.64 | 1.16 | 2,770 | 57.64 | 1.09 |
| No (approve gender violence) | 4,130 | 49.36 | 1.16 | 1,639 | 42.36 | 1.09 |
| Gender violence is not justified when wife refuses to have sex with him | | | | | | |
| Yes (disapprove gender violence) | 3,144 | 47.27 | 1.15 | 3,028 | 64.01 | 0.99 |
| No (approve gender violence) | 4,307 | 52.73 | 1.15 | 1,381 | 35.99 | 0.99 |
| Gender violence is not justified when wife burns the food | | | | | | |
| Yes (disapprove gender violence) | 5,126 | 72.59 | 1.02 | 3,651 | 79.79 | 0.83 |
| No (approve gender violence) | 2,325 | 27.41 | 1.02 | 758 | 20.21 | 0.83 |
| **Perceptions of gender norms for sex negotiation** | | | | | | |
| Perceive negotiation ability with both aspects | 1,188 | 17.74 | 0.81 | 2,502 | 56.06 | 1.17 |
| Do not completely perceive the ability | 6,263 | 82.26 | 0.81 | 1,907 | 43.94 | 1.17 |
| Gender norms for sex negotiation | | | | | | |
| Cannot refuse sex | 5,257 | 68.18 | 1.01 | 1,092 | 25.90 | 1.10 |
| Can refuse sex | 2,054 | 29.57 | 1.01 | 3,182 | 71.56 | 1.09 |
| Don't know, not sure, depends | 140 | 2.25 | 0.27 | 135 | 2.54 | 0.28 |
| Gender norms for condom negotiation | | | | | | |
| Cannot ask to use condom | 5,125 | 65.92 | 1.03 | 1,218 | 28.12 | 1.11 |
| Can ask to use condom | 2,064 | 30.61 | 1.00 | 2,901 | 66.34 | 1.19 |
| Don't know, not sure, depends | 262 | 3.64 | 0.38 | 290 | 5.54 | 0.45 |

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# Chapter 3

# The Relationship of Women's Status and Empowerment with Skilled Birth Attendant Use at Childbirth in Senegal and Tanzania (Aim 1)

## 3.1. Background

Maternal mortality is considered to be one of the greatest public health disparities of our time, as 99% of maternal deaths occur in low-and middle-income countries and the vast majority of these deaths are preventable. This disparity is particularly pronounced in sub-Saharan Africa where the lifetime risk of maternal death is 1 in 38 women, as compared to the global average of 1 in 190 women (WHO, 2014). Whereas other areas of the world have witnessed substantial reductions in maternal mortality, in sub-Saharan Africa these reductions have been minimal, and mortality levels have stagnated. The estimated Maternal Mortality Ratio (MMR) (i.e., number of maternal deaths per 100,000 live births) in sub-Saharan Africa is 510 – more than twice as high as the global average of 210 (WHO, 2014). These disparities are far greater than that observed with child or neonatal mortality (Ronsmans et al., 2006).

Evidence indicates that survival for women and newborns improves with professional care at childbirth, such as that provided by a Skilled Birth Attendant (SBA) (WHO, 2004). An SBA is defined as an accredited health professional – such as a midwife,

doctor, or nurse – who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the identification, management and referral of complications in women and newborns (WHO, 2004). Use of an SBA at childbirth has been identified as the most effective contemporary programmatic approach to addressing maternal mortality with the potential to avert 16 to 33 percent of maternal deaths (Graham et al, 2001).

In sub-Saharan Africa, however, only half of deliveries are attended by SBAs, and there has been little progress in increasing the proportion of SBA use over the past few decades (UN, 2014). A complex set of factors influence the likelihood of maternal mortality and delivery care use among women in low- and middle-income countries, including education and economic status, physical distance to facilities, availability of transportation, and actual and perceived quality of care (Koblinsky et al., 2006; Thaddeus&Maine, 1994). Additionally, the status of women in their households and communities, as well as women's power in deciding the type of care and provider are strongly predictive of reproductive health care utilization, including SBA use (Koblinsky et al., 2006; Malhotora, et al. 2002; Thaddeus&Maine, 1994).

Women's status and empowerment are terms that have been used in the literature to describe the social position of women and their ability to make decisions and take action on issues affecting their well-being (Malhotra, et al. 2002; Kabeer, 2001). While there are other

related terms (e.g., women's autonomy) and discussions as to the differentiation or overlap among these terms, generally ***women's status*** is defined as "women's overall position in the society" (Safilios-Rothchild, 1982), which encompasses their educational, cultural, economic, legal, and political position in a given society (Thaddeus&Maine, 1994).

***Women's empowerment*** is another term used to describe women's position in society, though has been differentiated from women's status as the *process* by which those who have been denied the ability to make strategic life choices acquire such ability (Kabeer, 2001). As defined by Kabeer (2001), the ability to exercise choice comprises three inter-related dimensions – resources (as pre-conditions), agency (as process), and achievements (as outcomes). Women's empowerment has been mostly operationalized and measured using proxy measures – women's participation in household decision-making, and access to, or control over household resources like income (Malhotra et al., 2002; Upadhyay et al., 2014). Perceptions of gender norms, which mostly represent the relationship of women with their partners and perceived equity in power and resources, are also frequently examined (Malhotra et al., 2002; Upadhyay et al., 2014). Early marriage and/or childbearing are also assessed to be reflective of women's status and/or empowerment in some settings (Hindin, 2012), as they are major strategic events in women's lives, although in reality it has been contested if they are their true "choices" (Lee-Rife et al., 2012; UN 1995).

Previous examinations of women's status, mostly operationalized as women's education, generally indicate positive relationships with delivery care use and reproductive health outcomes, yet the evidence regarding women's empowerment is mixed. Scholars operationalized delivery care use either as SBA use and/or facility delivery, which are different but interrelated and both are relevant to assess delivery care use. National-level studies using Demographic and Health Survey (DHS) datasets from Africa have consistently found a positive association between education and delivery care use and/or outcomes (Shiffman, 2000; Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011).

The effects of other sociodemographic characteristics of women and households do not yield clear patterns across countries. For example, the effect of employment on delivery care use is mixed across African countries – positively in Ethiopia, Eritrea, Liberia, Nigeria and Mali, and negatively in Rwanda and Uganda (Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008). The influence of marital and household relationship (e.g., polygamous/monogamous union; household headship) on delivery care use is not well studied. One recent study in Kenya found no effect of marital relationship status on delivery care use (Kitui et al. 2013), though other studies suggest its important influence on reproductive health (e.g., fertility intention) (Upadhyay&Karasek,

2010). Son preference is common in Africa (Fuse, 2008) yet the implication of having son(s) and its influence on delivery care use is not well known. Many of these studies did not explicitly examine women's empowerment (Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011).

Among studies that include measures of women's status and empowerment, these measures were found to be positively associated with delivery care use in general; however, the results are mixed across countries and regions in Africa (Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010). A meta-analysis by Ahmed et al. (2010) found that, based on the pooled odds ratios, household decision-making participation was positively associated with SBA use in 31 countries (including 21 African countries). Yet in another African study decision-making was positively associated with facility delivery only in Nigeria, but not in seven other African countries (Singh et al., 2011). While the literature generally indicates the need to examine the role of women's status and empowerment on delivery care use, the way in which these constructs are defined and related to delivery care use varies across settings.

The synthesis of evidence is further constrained due to the limitations of methodologies. The positive relationship of empowerment with women's education and other sociodemographic factors (e.g., employment), as well as between empowerment and the health of women and their families (e.g., child health and low fertility) has been generally

supported (Malhotra et al., 2002). However, the evidence is not consistent, and is likely due, at least in part, to differences in the ways in which women's status and empowerment are conceptualized, operationalized, and measured across studies (Malhotra et al., 2002; Upadhyay et al., 2014).

For example, despite strong evidence of the complex, multidimensional, and culturally-defined nature of empowerment, few studies consider the structure of empowerment dimensions in a given setting (Do&Kurimoto, 2012; Woldemicael&Tenkoranga, 2010; Pallitto&O'Campo, 2005; Agarwala&Lynch, 2006; Kishor&Subaiya, 2008) or examine the varied relationships between measures of women's empowerment and reproductive health behaviors (Singh, 2010; Snow et al., 2013; Upadhyay&Karasek, 2010; Woldemicael, 2010). Only two DHS studies on delivery care use examine both the multidimensionality and contextual differences in women's empowerment in Africa by assessing the influence of various measures of empowerment across multiple countries (Singh et al., 2011; Woldemicael, 2010). Moreover, none of these studies on delivery care use examine the effect of age at first marriage and/or childbearing, despite growing concern about the negative effect of early childbearing on empowerment in Africa (Hindin, 2012), which in turn can negatively affect delivery care use and outcomes (WHO, 2011).

This study examined the relationship of women's status and empowerment with SBA use at childbirth in Senegal and Tanzania, settings with high levels of maternal mortality. Although women's status and empowerment are critical to the improvement of maternal health in Africa, there are limited analyses that examine this relationship and compare differences across multiple African countries. To address this persistent gap in the literature, this study explored the structure and multiple dimensions of women's empowerment in two distinct study settings in sub-Saharan Africa, and examined the relative contribution of each empowerment dimension on SBA use to assess the multidimensionality and contextual nature of empowerment.

## 3.2. Methods

### (1) Study Settings and Data

This study investigated the use of SBAs in Senegal (SN) and Tanzania (TZ). These two countries are similar with respect to key heath indicators but culturally and economically different from one another. Their colonial and post-colonial political histories, status of women, religious orientation, and health systems are also quite different, making them useful countries to compare. Child health and fertility indicators are quite similar in the two countries – Total Fertility Rates are 5.0 in SN and 5.4 in TZ, and Infant Mortality Rates are 50 per 1,000 births in both countries (NBS Tanzania and Macro, 2012; ANSD Senegal et

Macro, 2012), yet the national Gross Domestic Products per capita (GDP in USD) in Senegal (1,032.7) is twice that of Tanzania (516.2) (UN, 2013). Maternal mortality ratios are similar across the two countries (370 per 100,000 in SN and 460 in TZ)(NBS Tanzania and Macro, 2012; ANSD Senegal et Macro, 2012).

The trend of health service use and availability, as well as sociocultural contexts, also differs across these two settings. In Tanzania, half of the recent births in the last five years occurred at health facilities (50.2%), compared to almost three quarters (72.8%) in Senegal (NBS Tanzania&Macro, 2012; ANSD Senegal&Macro, 2012). There are more health facilities (in terms of density per population), but relatively fewer health professionals available in Tanzania than in Senegal (WHO, 2010, 2014; Tanzania ministries of health&WHO, 2007). Traditional customs in Tanzania have generally prevented women's activities outside the household (Croll, 1981); however, there are recent shifts in sociocultural traditions and norms which appear to have advanced women's status and empowerment and promoted reproductive health behaviors and service use (McCloskey et al., 2005; Lausen&Hollos, 2003). In general, Islamic traditions are believed to negatively influence women's status, and previous examinations demonstrate that women's low status and empowerment make it less likely that they use maternal health services in Senegal (Faye, 2008, 2010). Yet Senegalese women have been renowned in their socioeconomic and political participation due to local women's organizations and governmental efforts (e.g.,

gender sensitive development programs and decentralization processes) (Sieveking, 2007; Patterson, 2002). These advantages, such as socioeconomic and political power, and freedom of mobility, may be indicative of women's higher empowerment status and can positively influence delivery care use in Senegal.

This study used data from the 2010-11 Senegal and 2010 Tanzania Demographic and Health Surveys (DHS), nationally representative household surveys that collected data on a variety of population, health, and nutrition issues. The study sample consisted of all births reported by currently married women that occurred in the five years preceding each survey. The total number of women who gave birth during this period was 8,148 in Senegal and 5,349 in Tanzania. Questions on household decision-making participation were asked to currently married women only, thus unmarried women were dropped from the analysis. Furthermore, a few women were dropped for missing data on the decision-making questions (n=11 in TZ) and the perceptions of gender norms questions (n=119 in SN and 82 in TZ).

Observations were weighted using individual and household weights to adjust for differences in the probability of selection and interview among cases in the sample. The final study sample included 7,033 women (weighted) and 7,451(unweighted) in Senegal, and 4,445 women (weighted) and 4,409 (unweighted) in Tanzania. Only 1.6% over the potential female sample in Senegal and 2.1% in Tanzania (1.5 % over the potential birth sample in SN and 2.0 % in TZ) were missing, thus minimizing potential bias due to missing observations.

The total numbers of births to these women were 10,668 (weighted) and 11,431 (unweighted) in Senegal, and 6,748 (weighted) and 6,756 (unweighted) in Tanzania, after excluding the births about which the information of delivery assistance was missing (n=4 in SN, 24 in TZ). The weighted mean number of births to the women sample was 1.52 in both countries (ranges 1-5 in SN and 1-6 in TZ).

### *Dependent Variable*

***SBA use*** at childbirth was operationalized as the use of an SBA at childbirth(s) in the five years preceding the survey. The variable was recoded as binary, in accordance with the WHO definition of SBAs (WHO, 2004). The SBAs included doctor or assistant medical officer, clinical officer, nurse or midwife; non-SBAs included MCH aide, village health worker, Traditional Birth Attendant, relative or friend, other, or no-one at the delivery.

### *Independent Variables*

***Women's education*** served as a proxy measure of women's status in this analysis. The survey asked women to report on the highest level of school that she had attended. The variable was recoded as: no formal education; primary attended; and secondary or higher attended.

***Women's Empowerment*** is operationalized through four dimensions of that were suggested by Exploratory Factor Analysis (see below for description of methods): Household decision-making power, perceptions against violence, perceptions of sex negotiation, and age at first marriage.

***A) Household decision-making power*** was examined as a summative variable. The survey asked women about their participation in decisions regarding household matters (e.g., own health care, major household purchases, and visits to family or relatives). The variables were first recoded into binary to examine if the respondent participated in the decision, either alone or jointly with their husband, or not. A summative variable captured the number of decisions in which women participated (scored 0-3).

***B)*** Two sets of questions in the DHS focused on perceived gender norms. The first domain, ***perceptions of gender norms against violence,*** asked about women's acceptance of wife-beating by her husband under five situations – if she goes out without telling him, neglects the children, argues with him, refuses to have sex with him, or burns the food. Each of the variables was first recoded as binary (i.e., yes or no) then summed to create a scale capturing the number of situations in which women do NOT accept the violence (scored 0-5), with

higher numbers indicating lower acceptance of gender violence and more progressive gender norms.

***C)*** The second domain, ***perceptions of gender norms for sex negotiation*** asked about women's perceived ability to negotiate sexual relations – if the respondent can refuse having sex or can ask her partner to use a condom. The variables were recoded to determine if the respondent can refuse/ask, or not (i.e., cannot refuse/ask, don't know, not sure, or depends). A summative variable captured the number of situations in which women think that they can negotiate with their husband (scored 0-2).

***D) Age at first marriage*** was examined as a continuous variable that was calculated based on the date of the first marriage or union ("living with a man as if married") and the date of birth of the respondent.

***Control Variables***

***Sociodemographic characteristics of women and households*** included women's age, parity, employment for payment, household wealth, marital and household relationship, the gender composition of children, and the place of residence. Women's age at the time of delivery was included as a continuous variable based on preliminary analysis indicating a

linear relationship with SBA use. Parity (i.e., the birth order of the children) was a categorical variable. Employment for payment was a binary measure defined as a woman who had been employed for cash or in-kind in the last 12 months, or not. Household wealth was examined using household asset data, such as ownership of consumer items and home attributes. Principal component analysis was conducted by MEASURE DHS to develop a ranking of household wealth according to the scores, and households were then divided into quintiles (NBS Tanzania&Macro, 2011). Marital relationship was assessed as categorical – monogamous union, polygamous as a first wife, or polygamous as a second wife or lower – to examine the potential differences by the type of marital relationship and wife order. Household relationship was assessed as binary – if the respondent was a household head or not. The gender composition of children was examined if the respondent had at least one living son or not at the time of the delivery as binary, considering the traditional value or preference for son that can reflect women's status and/or power in Africa (Fuse, 2008). Place of residence indicated if the respondent lived in an urban or rural area. These control variables were available in both countries. Other important variables (e.g., religion and ethnicity) were examined in separate models, but are not presented in the final models as they were unavailable in Tanzania.

***Perceived difficulty in accessing health care*** was also included as a control variable, which assessed if the respondent perceives difficulty when seeking health care. The questions

included: getting permission to go; getting money needed for advice/treatment; the distance to the healthy facility; or not wanting to go alone. The variables were first recoded into binary variables to show if the respondent perceived a big problem or not (i.e., not a big problem or not a problem at all), then recoded into a summative scale (scored 0-4), with higher scores indicating higher perceived difficulties.

**(2) Analytic Strategies**

Data analysis was conducted in three main steps. First, descriptive analyses were conducted using SAS 9.3 to assess the distribution of and to describe the variables. Second, factor analysis was conducted using Mplus 7.11. Exploratory Factor Analysis (EFA) identified the underlying structure of the set of indicators of empowerment, based on a geomin rotation, an oblique type of rotation that assumes the correlations among factors and factor loadings of each indicator. Confirmatory Factor Analysis (CFA) assessed the appropriateness and generalizability of the defined structure (Pett, 2003).

Third, sequential regression analyses were conducted, using SAS, according to the elaboration model approach. This is an explanatory model to determine if an empirical association between the focal independent and dependent variables potentially involves a causal connection (Rosenberg, 1968; Aneshensel, 2013). The simple (unadjusted) logistic regression was conducted first to examine the bivariate associations between SBA use and

each of the explanatory variables. Next, the multivariate logistic regression was conducted that included all of the control variables found to be significant in the bivariate models. Last, the final multivariate logistic regression models added the measures of women's empowerment. The variance inflation factor was assessed for all the variables in the model and shown to be below cut-off point of 10, thus the multicollinearity is minimal.

All of the analyses were conducted accounting for individual weights, clusters (i.e., Primary Sampling Unit), and sample strata using the survey analysis commands. Given that the study examined births occurring to women nested in households, this analysis corrected the standard errors for clustering by woman and household using the Taylor Series linearization method (Williams, 2000). Model fit was assessed though Likelihood Ratio (LR) chi-square test and Wald chi-square test.

### 3.3. Results

The descriptive results of women in this study are shown in Table 1. Almost half of these women used SBA at the last birth (50.1%) in Tanzania, as compared to almost two-thirds in Senegal (66.3%).[2]

Overall, Tanzanian women reported higher levels of women's status and empowerment as compared to women in Senegal. On average, women in Tanzania

[2] Almost half of the female study sample (3,657 in SN, 2,271 in TZ) had multiple births in the five years preceding the survey. For regression analysis all births in the five years were included. The proportion of SBA use for all births (64.6% in SN, 47.5% in TZ) is similar to the proportion of SBA use for the most recent births.

participated in more household decisions and reported more cases in which gender violence was not justified, as compared to women in Senegal (0.92 in SN and 1.43 in TZ out of 3 household decisions; 2.80 in SN and 3.16 in TZ out of 5 score regarding gender violence). Similarly, Tanzanian women reported higher perceived levels of negotiation in their sexual relations as compared to Senegalese women (Mean 0.60 in SN and 1.38 in TZ out of 2). Women in Tanzania had higher levels of education, parity, monogamous unions, and were more likely to live in rural areas as compared to Senegalese women; however, the mean age at marriage/union is just the same (Mean 18.3 years in SN and TZ).

Results from the EFA identified three underlying factors from the ten indicators related to household decision-making and perceptions of gender norms – household decision-making power, perceptions of gender norms against violence, and perceptions for sex negotiation (Table 3.2) (Eigenvalues >1.0). Age at first marriage had very low loadings (e.g., less than 0.2) on all of the identified factors, suggesting that this is a separate dimension from the others. CFA results supported the appropriateness of this structure. The correlations between these identified three factors were low (< 0.313 in SN; < 0.252 in TZ), suggesting that each of them are distinct and may have disparate effects on SBA use.

Tables 3.3 and 3.4 show the results of the sequential regression analyses predicting the odds of using SBA(s) at childbirth in Senegal and Tanzania. The bivariate relationships were first tested between SBA use and each of the explanatory variables (Model 1 in Table

3.3, 3.4). Most of the explanatory variables show statistically significant associations with SBA use. For example, women's secondary education is significantly and positively associated with SBA use both in Senegal and Tanzania. Only a couple of exceptions are age at delivery and employment for payment in Senegal, and household headship in Tanzania.

In the adjusted model (Model 2 in Table 3.3, 3.4), women's education is significantly associated with SBA use, even after adjusting for control variables in Tanzania. Relative to births of women with primary education, births occurring to women with no education had 33.3% lower odds of being attended by an SBA ($p<0.001$); and women with secondary or higher education had 51.5% higher odds ($p<0.01$). Yet in Senegal, formal education is no longer significantly associated with SBA use in the adjusted model.

The patterns of association between sociodemographic characteristics and SBA use show similarities across the two settings. Women's age at delivery, household wealth, and urban residence are positively associated with SBA use, while polygamous union (either as first wife, or second or lower) and perceived difficulty in accessing health care are negatively associated with SBA use. Parity is also inversely related to SBA use such that women having their first birth were more likely to use an SBA (OR=3.13 and 2.26 in TZ and SN, respectively), as compared to the fourth or higher order birth. Employment for payment is significantly associated with SBA but in the opposite directions in the two settings – positively in Tanzania (OR=1.23), yet negatively related in Senegal (OR=0.79).

In the final multivariate model including all of the empowerment measures (Model 3 in Table 3.3, 3.4), women's education remains significantly associated with SBA use in Tanzania, but not in Senegal. The inclusion of the women's empowerment variables diminished the effects of some of the demographic variables; however, most of the relationships remain significant.

The association of SBA use with the women's empowerment variables varies by proxy measure and by country. For example, household decision-making participation is the only measure of the four measures tested that are significantly associated with SBA use in Tanzania. Moreover, although every additional household decision-making participation is associated with 12.9% higher odds of using SBA in Tanzania, this relationship is not significant in Senegal. Conversely, perceptions against violence, perceptions for sex negotiation and age at first marriage are significantly and positively associated with SBA use in Senegal, but are not associated with SBA use in Tanzania. In Senegal, every additional measure in which women indicated a more progressive gender norms against violence and for sex negotiation was associated with higher odds of SBA use (OR=1.091 and OR=1.161, respectively). Similarly, a one-year increase in age at marriage is related to 2.7% higher odds of using SBA only in Senegal.

## 3.4. Discussion

This study employed a multidimensional operationalization of women's empowerment to examine the relationship of women's status and empowerment with SBA use at childbirth in two distinct settings of sub-Saharan Africa – Senegal and Tanzania. The results confirmed that not only are women's status and empowerment multidimensional, but also that the independent effects of these dimensions on SBA use vary across settings.

There are three key findings from this analysis. First, this study demonstrated the varied relationship of women's formal education and SBA use by context. Despite evidence generally demonstrating women's education as a positive determinant for maternal and child health (Thaddeus&Maine, 1994; Koblinsky, 2006), formal education was positively related to SBA use in Tanzania, but not in Senegal in the adjusted models. This finding may suggest that formal education may not always be the most appropriate proxy measure of women's status in some settings. For example, in Senegal where informal and religious education is common and recognized (e.g., Islamic schools and/or education), it may be more appropriate to measure additional forms of knowledge sharing and teaching institutions. Moreover, it may also be that given that the simple bivariate association was significant between formal education and SBA use in Senegal, the influence of education is likely to be attenuated by other important sociodemographic characteristics (e.g., household wealth) and/or by the inclusion of the women's empowerment proxy measures. This highlights the importance of

analyses that investigate the relationships and pathways linking women's status, women's empowerment and their potential effects on the health and well-being of women and their families.

Second, and related to the first finding, is that the relationship between individual dimensions of women's empowerment and SBA use varied across the two study settings, and confirmed the multidimensional influences of empowerment on women's health. Women's household decision-making power was significantly associated with SBA use only in Tanzania, while age at first marriage, perceptions of gender norms against violence and for sex negotiation were significantly associated with SBA use in Senegal. These findings align with previous evidence and discussions that the notion of 'women's empowerment' is contextually defined, and is likely comprised of different dimensions and domains across study settings (Kishor&Subaiya, 2008; Singh et al., 2011). These contextual differences were also supported by findings from separate analyses indicating varied relationships between the women's sociodemographic characteristics and the empowerment dimensions. For example, household wealth was found to be positively associated with age at first marriage in Senegal, but not in Tanzania (See Table 2.14&2.15, Page 115-116), suggesting the different implications of early marriage in these settings and, thus, what these measures would represent with respect to women's status/empowerment in these two settings. It is possible that early marriage may be more financially driven in Senegal, but not in Tanzania. Further

explication of these processes and pathways would be more feasible with longitudinal data and with the inclusion of other background characteristics for women, such as information on household characteristics of women's natal families.

The effect of women's employment on SBA use also varied across the two settings, with employment being positively related to SBA use in Tanzania, and negatively related to SBA use in Senegal. These mixed findings are consistent with recent research showing varied relationships between employment and delivery care use (Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008), despite the fact that employment opportunity has been generally recognized as an enabling factor for women's empowerment (Kabeer, 2001; Malhotra et al., 2002). Findings from this and other studies suggest the various implications and reasons for women to work for payment – employment may represent women's access to economic markets and financial power in one context, while in another context, women may be more economically disadvantaged and may be forced to engage in earning activities irrespective of their choice and power (Kabeer, 1997). Indeed these variations were also demonstrated in the separate regression analyses on women's empowerment, findings that employment was differentially related to empowerment proxy measures across countries (See Table 2.14&2.15, Page 115-116).

This study entails some limitations despite its addressing several research gaps. This study employed cross-sectional survey datasets, thus any causal inference is tentative. The

direction of causation cannot be inferred due to potential reciprocal effects, despite relevant theories supporting the anticipated direction of relationship. In order to examine the effect of empowerment as a process, these relationships should be examined over time, ideally using longitudinal data. Furthermore, due to the differences in survey sampling and weighting across the two contexts, it was not possible statistically test for differences between the two settings. Given the limitations of logistic regression influenced by unobserved heterogeneity (Mood, 2010), the magnitude of coefficient was not directly and substantively compared across models, groups, and samples.

The operationalization and measurement of women's status and empowerment in these two settings were limited by what was available from the DHS surveys. Although these measures provide comparability of measures across international contexts, it is possible for example, that the household decision-making measures that were developed in the Asian context may not be as relevant in sub-Saharan Africa. Women's empowerment measures should ideally capture women's ability to decide on life strategic choices (e.g., marriage, divorce, sexuality). Thus, the extent to which the identified empowerment dimensions reflect true distinctions in women's position and choices within their respective societies is not clear. Related to this is the necessity of including more locally-defined and tested measures (Upadhyay et al., 2014), especially in studies that focus on a single country/setting.

Similarly, the DHS surveys only ask currently married women about household decision-making; thus, it is unknown if these findings are representative of unmarried women and adolescents. This limitation further emphasizes the importance of comprehensive decision-making questions that are relevant regardless of marital status. It is critical to examine girls' empowerment and its effect on reproductive health service use and outcomes, especially in light of growing evidence that adolescents are at greater risk of delivery without skilled professionals, unsafe abortion, and maternal deaths (WHO, 2011; Bearinger et al., 2007; Magadi et al., 2007; Neal et al., 2012; Wellings et al., 2006; Pandey et al., 2011).

Last, examining other important variables encompassing sociocultural factors and using moderation analysis could have further explained differences in the two countries. For example, testing the influence of religion and ethnicity would have been ideal, yet this information was only available for Senegal. However, a sensitivity analyses conducted to examine these relationships found that the relationship of education and empowerment with SBA use (in terms of direction and statistical significance) did not change even after controlling for religion and ethnicity (See sensitivity analysis 2.9.4, Page 109). Future research should further investigate these synergetic influences.

Despite these weaknesses, this study is one of the few studies that examined and incorporated a multidimensional investigation of women's empowerment on delivery care use in sub-Saharan Africa. The analysis found that the four dimensions of women's

empowerment influence delivery care use differently in the two settings, highlighting the importance of identifying the structure and respective influences of empowerment domains on health outcomes across study settings.

## 3.5. Conclusions

In summary, this study examined women's status and empowerment as determinants of SBA use, and confirmed the multidimensional and contextual nature of women's status and empowerment. Policies and programs should ensure the improvement of women's status and power, in an effort to accelerate maternal mortality reduction through SBA use. However, it is important to consider particular implications of empowerment to identify the most influential dimension(s) on delivery care use in a given context and to ensure appropriate allocations of resources in policies and programs.

**Table 3.1. Characteristics of participating, currently married women with at least one birth in last 5 years (weighted n=7,033 in SN; n=4,445 in TZ), Senegal and Tanzania Demographic and Health Surveys (DHS) 2010**

| | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | | Weighted | | | Weighted | |
| Variables | Freq | Mean or Proportion | SE | Freq | Mean or Proportion | SE |
| **Outcome** | | | | | | |
| Skilled Birth Attendant (SBA) use at the last birth | 4,251 | 66.30 | 1.27 | 2,233 | 50.95 | 1.51 |
| **Women's empowerment proxy measures** | | | | | | |
| Household decision-making power (scored 0-3) | | 0.92 | 0.03 | | 1.43 | 0.02 |
| Perceptions against violence (0-5) | | 2.80 | 0.05 | | 3.16 | 0.04 |
| Perceptions for sex negotiation (0-2) | | 0.60 | 0.02 | | 1.38 | 0.02 |
| Age at first marriage | | 18.29 | 0.10 | | 18.28 | 0.06 |
| **Demographics and perceived accessibility of health care** | | | | | | |
| Education | | | | | | |
| Formal education attendance (in years) | | 1.79 | 0.08 | | 5.01 | 0.10 |
| No formal education | 5,577 | 70.54 | 1.21 | 1,082 | 24.42 | 1.22 |
| Primary attended | 1,384 | 20.74 | 1.01 | 2,771 | 68.93 | 1.18 |
| Secondary or above attended | 490 | 8.71 | 0.57 | 556 | 6.65 | 0.52 |
| Age at childbirth | | 29.40 | 0.12 | | 29.38 | 0.15 |
| Household wealth quintile | | | | | | |
| Poorest | 2,264 | 22.38 | 1.31 | 818 | 19.58 | 1.08 |
| Poorer | 1,882 | 20.95 | 1.18 | 957 | 22.61 | 0.96 |
| Middle | 1,534 | 19.19 | 1.13 | 905 | 21.47 | 0.92 |
| Richer | 1,056 | 19.85 | 1.34 | 954 | 19.99 | 1.12 |
| Richest | 715 | 17.63 | 1.12 | 775 | 16.35 | 1.14 |
| Employment for payment | | | | | | |
| Employed (currently or last 12 months) | 3,386 | 46.04 | 1.12 | 1,717 | 38.07 | 1.10 |
| Parity (Total # of children ever born to women) | | 3.81 | 0.04 | | 3.90 | 0.05 |
| Marital relationships | | | | | | |
| Monogamous union | 4,909 | 68.19 | 0.83 | 3,394 | 78.87 | 0.53 |
| Polygamous as 1st wife | 991 | 12.73 | 0.44 | 434 | 8.97 | 0.53 |
| Polygamous as 2nd or lower | 1,550 | 19.08 | 0.55 | 549 | 12.16 | 0.82 |
| Household head | 322 | 4.98 | 0.38 | 251 | 5.67 | 0.47 |
| Place of residence | | | | | | |
| Urban | 2,267 | 39.95 | 1.62 | 878 | 21.67 | 1.18 |
| Rural | 5,184 | 60.05 | 1.62 | 3,531 | 78.33 | 1.18 |
| Perceived difficulty in accessing health care (Mean, scored 0-5) | | 1.23 | 0.04 | | 0.53 | 0.02 |

Note: Characteristics related to births were also assessed including all births that women delivered in the last five years (weighted birth n=10,668 in SN; n=6,748 in TZ). The proportion of SBA use at the recent birth(s) was 64.6% in SN; 47.5% in TZ. The mean of birth order of each birth was 3.67 in SN; 3.75 in TZ. The proportion of births that took place when women had living son(s) was 60.2% in SN; 62.3% in TZ.

Frequency missing with demographic characteristics=32 (with marital relationships), and 17 (with perceived difficulty in accessing health care) in Tanzania. Missing=1 (with marital relationships) in Senegal.

**Table 3.2. Factor analysis for indicators of empowerment (weighted n=7,033 in Senegal; 4,445 in Tanzania), Demographic and Health Survey (DHS) 2010**

| *Latent construct* | *Indicator* | *Aspects that survey asked* | *Factor loadings* | |
|---|---|---|---|---|
| | | | *Senegal* | *Tanzania* |
| Household decision-making | Hlt | Decision on own health care | 0.916* | 0.795* |
| | Purc | Decision on major household purchases | 0.869* | 0.865* |
| | Visit | Decision on visits to family or relatives | 0.851* | 0.939* |
| Perceptions of gender norms against violence | Gout | Violence if going out without telling husband | 0.917* | 0.890* |
| | Negl | Violence if neglects the children | 0.933* | 0.922* |
| | Argue | Violence if argues with him | 0.963* | 0.929* |
| | Refs | Violence if refuses to have sex with him | 0.911* | 0.883* |
| | Burnf | Violence if burns the food | 0.822* | 0.863* |
| Gender norms for sex negotiation | Negsex | Perceived ability in refusing sex | 0.803* | 0.844* |
| | Negcon | Perceived ability in asking condom use | 0.771* | 0.693* |

Note: Factor loadings from the three factor models are presented. p<.05*.
Model fit statistics: [EFA for Senegal] RMSEA=0.034, CFI=0.996, TLI=0.989, SRMS=0.013;
[EFA for Tanzania] RMSEA=0.036, CFI=0.996, TLI=0.989, SRMS=0.018.

**Table 3.3. Bivariate and multivariate logistic regression analyses of skilled birth attendant use for births occurring in last 5 years (weighted n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| | | Model 1 unadjusted (bivariate) | | | Model 2 adjusted | | | Model 3 final adjusted | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | CI | | OR | CI | | OR | CI | |
| **Independent variable** | | | | | | | | | | |
| Women's education | No education | 0.355 *** | 0.303 | 0.415 | 0.888 | 0.741 | 1.064 | 0.972 | 0.809 | 1.167 |
| (Ref.=Primary edu) | Secondary or above | 2.064*** | 1.457 | 2.922 | 0.994 | 0.659 | 1.501 | 0.937 | 0.616 | 1.423 |
| **Control variables** | | | | | | | | | | |
| Age at childbirth | | 1.003 | 0.995 | 1.011 | 1.029 *** | 1.018 | 1.041 | 1.017 * | 1.004 | 1.031 |
| Household wealth | Poorer | 2.476*** | 2.165 | 2.833 | 2.275 *** | 1.982 | 2.612 | 2.183 *** | 1.9 | 2.508 |
| (Ref.=Poorest) | Middle | 6.927*** | 5.927 | 8.097 | 4.547 *** | 3.84 | 5.384 | 4.273 *** | 3.604 | 5.067 |
| | Richer | 17.985 | 14.295 | 22.627 | 7.584 *** | 5.89 | 9.765 | 6.740 *** | 5.22 | 8.702 |
| | Richest | 52.422*** | 36.208 | 75.896 | 18.721 *** | 12.88 | 27.22 | 15.978 *** | 10.944 | 23.327 |
| Parity | First birth | 2.666*** | 2.330 | 3.050 | 2.256 *** | 1.797 | 2.832 | 1.993 *** | 1.566 | 2.537 |
| (Ref.= 4th or more) | Second or third | 1.535 | 1.370 | 1.719 | 1.274 ** | 1.091 | 1.489 | 1.153 | 0.977 | 1.36 |
| Employment for payment | (Ref.=not employed) | 1.095 | 0.978 | 1.225 | 0.788 *** | 0.694 | 0.894 | 0.797 *** | 0.703 | 0.904 |
| Household head | (Ref.=not head) | 1.693*** | 1.261 | 2.274 | 1.166 | 0.835 | 1.627 | 1.154 | 0.821 | 1.624 |
| Urban residence | (Ref.=rural) | 10.066*** | 8.594 | 11.790 | 3.032 *** | 2.526 | 3.64 | 2.854 *** | 2.377 | 3.426 |
| Marital relationship | Polygamous as 1st wife | 0.630** | 0.533 | 0.744 | 0.772 ** | 0.641 | 0.929 | 0.814 * | 0.676 | 0.98 |
| (Ref.=monogamous) | 2nd or lower | 0.648** | 0.567 | 0.741 | 0.733 *** | 0.63 | 0.853 | 0.764 *** | 0.656 | 0.889 |
| Having son(s) | (Ref.=no living son) | 0.565*** | 0.509 | 0.627 | 0.858 | 0.736 | 1.000 | 0.868 | 0.743 | 1.012 |
| Perceived difficulty in accessing health care (0-4) | | 0.655*** | 0.625 | 0.687 | 0.864 *** | 0.825 | 0.905 | 0.865 *** | 0.825 | 0.907 |
| **Women's empowerment proxy measures** | | | | | | | | | | |
| Household decision-making power (0-3) | | 1.229*** | 1.169 | 1.293 | | | | 1.025 | 0.969 | 1.084 |
| Perception against violence (0-5) | | 1.306*** | 1.271 | 1.342 | | | | 1.091 *** | 1.059 | 1.124 |
| Perception for sex negotiation (0-2) | | 1.508*** | 1.397 | 1.627 | | | | 1.161 *** | 1.064 | 1.267 |
| Age at first marriage | | 1.131*** | 1.115 | 1.146 | | | | 1.027 ** | 1.010 | 1.044 |
| **Intercept** (coefficient) | | | | | -1.2674*** | | | -1.704*** | | |
| **Model statistics** | | | | | | | | | | |
| LR (Chi-square) | | | | | 3670.2785 | | | 3762.405 | | |
| Wald (Chi-square) | | | | | 1303.6847 | | | 1325.9176 | | |
| DF | | | | | 16 | | | 20 | | |
| P | | | | | *** | | | *** | | |

Note: p<.001 ***, p<.01**, p<.05*. Model 1 (simple binary regression model) was assessed by each explanatory variable, and the model statistics of each model are not reported in the table. For the overall association, wald chi-square tests (from Type 3 Analysis of Effects) were assessed with education, wealth, parity, and marital relationship, showing significance at p<.001.

**Table 3.4. Bivariate and multivariate logistic regression analyses of skilled birth attendant use for births occurring in last 5 years (weighted n=6,748 in Tanzania), Demographic and Health Survey (DHS) 2010**

| Variables | | Model 1 unadjusted (bivariate) | | | Model 2 adjusted | | | Model 3 final adjusted | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | OR | CI | | OR | CI | | OR | CI | |
| **Independent variable** | | | | | | | | | | |
| Highest education | No education | 0.457*** | 0.386 | 0.542 | 0.667 *** | 0.546 | 0.814 | 0.702 *** | 0.574 | 0.858 |
| (Ref.=Primary education) | Secondary or above | 5.564*** | 4.088 | 7.573 | 1.515 ** | 1.111 | 2.066 | 1.428 * | 1.047 | 1.946 |
| **Control variables** | | | | | | | | | | |
| Age at childbirth | | 0.986** | 0.976 | 0.996 | 1.049 *** | 1.032 | 1.067 | 1.040 *** | 1.021 | 1.06 |
| Household wealth | Poorer | 1.169*** | 0.942 | 1.451 | 1.024 | 0.816 | 1.286 | 1.013 | 0.805 | 1.274 |
| (Ref.=Poorest) | Middle | 1.844*** | 1.487 | 2.286 | 1.531 *** | 1.217 | 1.925 | 1.528 *** | 1.214 | 1.923 |
| | Richer | 3.612** | 2.862 | 4.557 | 2.140 *** | 1.659 | 2.759 | 2.170 *** | 1.68 | 2.803 |
| | Richest | 21.612*** | 15.681 | 29.787 | 6.72*** | 4.033 | 9.141 | 5.836 *** | 3.895 | 8.744 |
| Parity | First birth | 2.757*** | 2.315 | 3.283 | 3.134 *** | 2.297 | 4.274 | 2.936 *** | 2.12 | 4.066 |
| (Ref.=4th or more) | Second or third | 1.731 | 1.502 | 1.996 | 1.901 *** | 1.537 | 2.35 | 1.778 *** | 1.422 | 2.223 |
| Employment for payment | (Ref.= not employed) | 2.163*** | 1.867 | 2.506 | 1.230 * | 1.038 | 1.457 | 1.197 * | 1.009 | 1.42 |
| Household head | (Ref.= not head) | 0.836 | 0.622 | 1.124 | 1.196 | 0.845 | 1.693 | 1.114 | 0.785 | 1.583 |
| Urban residence | (Ref.=Rural) | 7.305*** | 5.617 | 9.499 | 2.182*** | 1.582 | 3.011 | 2.183 *** | 1.589 | 2.999 |
| Marital relationship | Polygamous as 1st wife | 0.401*** | 0.314 | 0.513 | 0.541 *** | 0.414 | 0.707 | 0.566 *** | 0.433 | 0.739 |
| (Ref.=monogamous) | 2nd or lower | 0.560 | 0.449 | 0.699 | 0.639 *** | 0.494 | 0.827 | 0.672 ** | 0.519 | 0.87 |
| Having son(s) | (Ref.=No living son) | 0.550*** | 0.482 | 0.627 | 0.849 | 0.699 | 1.031 | 0.852 | 0.701 | 1.034 |
| Perceived difficulty in accessing health care (scored 0-4) | | 0.607 *** | 0.561 | 0.657 | 0.732* | 0.672 | 0.798 | 0.739 *** | 0.678 | 0.805 |
| **Women's empowerment proxy measures** | | | | | | | | | | |
| Household decision-making power (0-3) | | 1.208*** | 1.140 | 1.280 | | | | 1.129 *** | 1.056 | 1.206 |
| Perceptions against violence (0-5) | | 1.112*** | 1.072 | 1.153 | | | | 1.018 | 0.975 | 1.062 |
| Perceptions for sex negotiation (0-2) | | 1.376*** | 1.256 | 1.507 | | | | 1.108 | 0.999 | 1.230 |
| Age at first marriage | | 1.102*** | 1.075 | 1.130 | | | | 1.022 | 0.994 | 1.05 |
| **Intercept** (coefficient) | | | | | -1.983*** | | | -2.477*** | | |
| **Model statistics** | | | | | | | | | | |
| LR (Chi-square) | | | | | 1635.0332 | | | 1683.3702 | | |
| Wald (Chi-square) | | | | | 751.1497 | | | 755.8300 | | |
| DF | | | | | 16 | | | 20 | | |
| P | | | | | *** | | | *** | | |

Note: p<.001 ***, p<.01**, p<.05*. Model 1 (simple binary regression model) was assessed by each explanatory variable, and the model statistics of each model are not reported in the table. For the overall association, wald chi-square tests (from Type 3 Analysis of Effects) were assessed with education, wealth, parity, and marital relationship, showing significance at p<.001.

**Chapter Three References**


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# Chapter 4

## Examining the Effects of Women's Status and Empowerment on Delivery Care in Africa: A Mediation Analysis (Aim 2)

### 4.1. Introduction

Maternal mortality is a major public health challenge, with 99% of maternal deaths occurring in low-and middle-income countries. Most of these deaths are preventable. Despite efforts to reduce maternal deaths, progress has stagnated, especially in sub-Saharan Africa (SSA). The estimated Maternal Mortality Ratio (MMR) (i.e., number of maternal deaths per 100,000 live births) in SSA (510 per 100,000 births) is much higher than the global average of 210. The lifetime risk of maternal death is 1 in 38 women in SSA, which is strikingly higher as compared to the global average of 1 in 190 women (WHO, 2014).

Research indicates that survival for women and newborns improves with professional care at childbirth, such as that provided by a skilled birth attendant (SBA) (WHO, 2004). An SBA is an accredited health professional—such as a midwife, doctor, or nurse—skilled at managing normal (uncomplicated) pregnancies and childbirth, identifying

complications in women and newborns, and making the needed referrals (WHO, 2004). The use of a skilled birth attendant has the potential to avert 16 to 33 percent of maternal deaths (Graham et al, 2001); however, there has been little progress in reducing maternal mortality in sub-Saharan Africa over the past few decades, with only half of deliveries in the region attended by SBAs (UN, 2014).

A complex set of factors influence the use of delivery care and, therefore, the risk of maternal death in low- and middle-income countries – education and economic status, physical distance to facilities, availability of transportation, and actual and perceived quality of care (Koblinsky et al., 2006; Thaddeus&Maine, 1994). The status and power of women are also critical determinants of reproductive health care utilization, including delivery care (Koblinsky et al., 2006; Malhotora 2002; Thaddeus&Maine, 1994). Yet a critical examination of these influences and the related pathways to delivery care use are rarely investigated, particularly in sub-Saharan Africa where maternal mortality rates are the highest.

To address these persistent gaps in the literature, this study used DHS data from Senegal and Tanzania to address two study aims: 1) To develop an empirically- and theory-driven conceptual framework of women's empowerment and SBA use, and 2) To empirically test this framework using measures of women's empowerment from these two settings, and 3) To examine the causal pathways linking women's status, women's empowerment, and delivery care using a formal mediation analysis.

## *4.2. Background*

### *Women's status and empowerment*

The terms women's status and empowerment describe the social position of women and their ability to make decisions and take action on issues affecting their well-being. In general, ***women's status*** is defined as "women's overall position in the society" (Safilios-Rothschild, 1982), and encompasses their educational, cultural, economic, legal, and political position in a given society (Thaddeus&Maine, 1994). Whereas women's status generally focuses on women's position in society at a certain point in time, women's ***power*** is defined as "women's ability to control or change other women's or men's behaviors and the ability to determine important events in their lives" (Safilios-Rothschild, 1982).

Women's ***empowerment*** is often used to describe the *process* by which women who have been denied the ability to make strategic life choices acquire such ability (Kabeer, 2001). According to this definition, the ability to exercise choice comprises three inter-related dimensions – resources (as pre-conditions), agency (as process), and achievements (as outcomes) (Kabeer, 2001). Women's empowerment has been mostly operationalized with the proxy measures that represent "agency" and "resources", such as women's participation in household decision-making and a woman's access to and control over household resources (e.g., income) (Malhotra et al., 2002; Upadhyay et al., 2014). Perceived gender norms are also commonly assessed as proxy measures for women's empowerment mostly focusing on

relationships between couples/partners and perceived gender equity in power and access to resources (Malhotra et al., 2002; Upadhyay et al., 2014). Yet another domain of women's empowerment included in previous studies is the inclusion of major life strategic events, such as the age at which a woman is married and begins childbearing. Although some argue that these milestones may represent women's "achievements" as indicated by Kabeer (2001), others have questioned whether or not early marriage and childbearing are women's true choices (Lee-Rife et al. 2012; UN, 1995).

Though the definitions and operationalizations of women's empowerment have varied greatly in the empirical literature to date (Upadhyay, et al., 2014), it is commonly recognized that empowerment is inherently complex, multidimensional, and culturally-defined. As such, analyses that attempt to understand the relationships between women's status and empowerment and their effects on health service use, such as delivery care use, require an examination that considers sociocultural context and the potential for multiple and diverse pathways between these measures and health behaviors and outcomes.

***Women's status, empowerment, and delivery care use in sub-Saharan Africa***

The following synthesis of the literature describes findings from studies that assessed the determinants of SBA use and/or delivery at a health care facility. Together, these outcomes are referred to subsequently as "delivery care use". It should be noted that most

(but not all) facility deliveries are attended by an SBA, although an SBA may also assist with home births. Facility delivery and use of an SBA are both independently associated with better outcomes for mothers and their babies, as compared to non-facility delivery and use of no or non-skilled birth attendant; thus, a synthesis of studies examining both of these outcomes is presented below.

Findings on the association between women's status and delivery care use are generally consistent, especially with regard to women's education; but the evidence is mixed for women's empowerment. Previous studies on delivery care use commonly examined the influence of women's education either as a proxy measure of women's status (Pandey, 2011; Woldemicael, 2010; Ahmed et al., 2010) or as one of the explanatory variables among other sociodemographic variables (Magadi, 2007; Do&Fu, 2011; Woldemicael&Tenkorang, 2010; Singh, 2011; Jayaraman, 2008; Kitui, 2013; Babalola&Fatusi, 2009; Zere, 2011; Ochako, 2011).

Evidence from studies based on the nationally representative Demographic and Health Surveys (DHS), several of them focused on African countries, consistently suggests a positive association between education and delivery care use and/or outcomes (Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al. 2013; Ochako et al., 2011; Zere et al., 2011; Shiffman, 2000; Ahmed et al., 2010). Other sociodemographic characteristics such as women's

employment and type of marital relationship, do not yield a clear pattern across African countries. For example, women's employment is positively related to delivery care use in some countries (e.g., Ethiopia, Mali) while it is negatively related in others (e.g., Rwanda, Uganda) (Singh et al. 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Kitui et al. 2013).

Among studies that included women's status and empowerment measures, the influence of household decision-making on delivery care use (i.e., SBA use, facility delivery) is not consistent across African countries (Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010). A meta-analysis of 35 countries found that household decision-making was positively associated with SBA use (Ahmed et al., 2011), yet another African study of eight countries found a positive association between decision-making and facility delivery only in Nigeria, with no significant association in the other seven countries (e.g., Mali, Uganda) (Singh et al., 2011). Only two DHS studies on delivery care use in Africa have assessed multiple measures of empowerment, including decision-making and perceptions of gender norms, finding varied relationships between delivery care use and empowerment by measure and country. For example, decision-making is positively related in Eritrea and Nigeria only; and progressive perceptions against violence in Ethiopia, Ghana, and Nigeria alone among ten countries (Singh et al, 2011; Woldemicael, 2010).

***Research gaps and methodological challenges***

Although the literature generally demonstrates that women's status and empowerment influence delivery care use, the synthesis of evidence is challenged by difficulties in the operationalization and measurement of women's empowerment and its effects on health outcomes.

There are four main challenges to investigations in this area. First, despite strong evidence of the complexity, multidimensionality, and contextual nature of empowerment, few studies explore and then define the multi-dimensional structure of empowerment employing statistically appropriate procedures (e.g., factor analysis). Only a handful of studies conducted factor analysis to assess loadings in the pre-defined structure and/or dimensions (Woldemicael&Tenkoranga, 2010; Pallitto&O'Campo, 2005; Agarwala&Lynch 2006), and few have examined the contribution of different empowerment dimensions/aspects on reproductive health (Pallitto&O'Campo, 2005; Story&Burgard, 2012; Woldermicael, 2010; Singh et al. 2010; Snow et al., 2013; Upadhyay&Karasek, 2010). Another study developed one summative empowerment index that collapsed several empowerment domains (e.g., contribution to household income, decision-making, attitudes of gender-role) and found that each domain is related to contraceptive use differently by country (Do&Kurimoto, 2012). Thus such a composite index may mask the separate and potentially disparate influences of specific dimensions/aspects of empowerment on health outcomes.

Second, none of the existing DHS studies on delivery care use in Africa examine age at first marriage as a proxy measure of women's empowerment despite growing evidence of negative influences of early childbearing on empowerment in Africa (Hindin, 2012) and, in turn, on delivery care use and outcomes (WHO, 2011).

Third, none of the identified studies formally tested intervening effects of women's empowerment between women's status and SBA use, although there is a general understanding of empowerment as a mediating factor. A study in Kenya considered the mediating effect of women's autonomy as related to facility delivery (Fotso, 2009). Yet none of the study on delivery care use in Africa examined the mediation effect using formal statistical tests.

Fourth, despite evidence of the multidimensional and contextual nature of empowerment, exploration and documentation of these varying mechanisms and linkages and their effects on delivery care use across study settings is not well studied. The few comparative studies that have been conducted indicate a varied relationship of women's empowerment measures with reproductive health intentions/behaviors or sociodemographic determinants across settings (Singh et al., 2010; Snow et al., 2013; Upadhyay&Karasek, 2010; Kishor&Subaiya, 2008; Woldermicael, 2010), and underscore the importance of identifying an appropriate structure of empowerment dimensions in a given context.

For example, Kishor and Subaiya (2008) demonstrated differences in the sociodemographic determinants of the most commonly used empowerment proxy measures from DHS surveys – household decision-making power, perceptions of gender norms against violence, and perceptions of gender norms regarding sex negotiation – in their investigation across 23 countries. Specifically, they found significant distinctions between two sets of gender norm perceptions, and questioned the relevance of household decision-making questions, especially in African settings (Kishor&Subaiya, 2008). Recent African studies have also identified disparate effects of individual empowerment measures with men's or women's desired family size, and women's ability to control fertility across countries (i.e., the desired number of children of men or women, and women's ability to have the ideal number) (Snow et al., 2013; Upadhyay&Karasek, 2010).

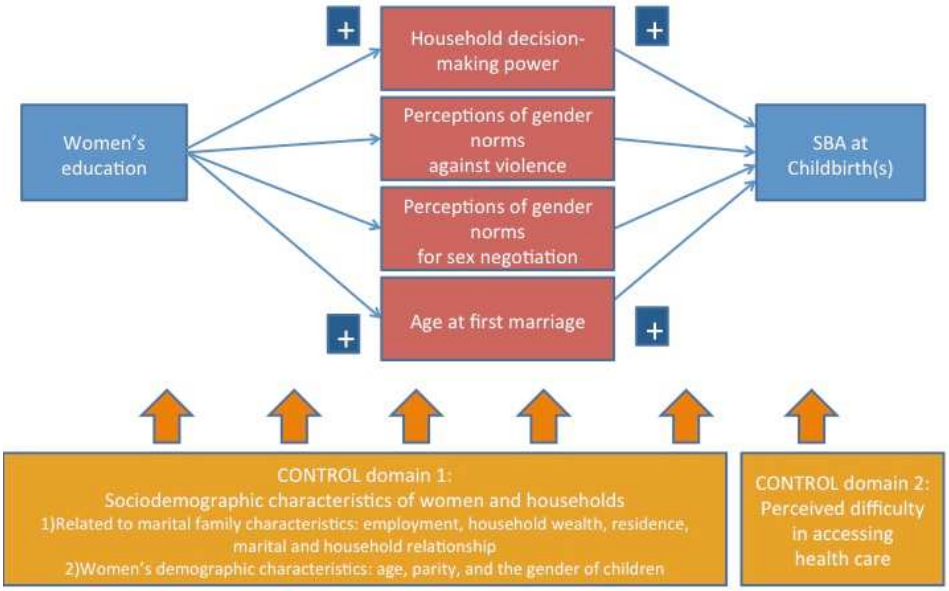
## 4.3. Conceptual Framework and Aims

### *Conceptual Framework*

The analyses conducted in this study draw on sociological theories on gender to identify and situate the underlying social issues that contribute to women's reluctance or inability to seek reproductive health services, leading to negative health outcomes such as maternal mortality (Blumberg, 1984; Collins et al., 1993; Connell, 1987). As illustrated in Figure 1, the relationship between women's status and reproductive health care use, including

SBA use, operates through women's ability to make decisions, perceptions of gender norms, and age at first marriage as a preceding factor of childbearing, which have been identified as determinants and underlying sociocutural factors affecting reproductive health behaviors and outcomes (Blumberg, 1984; Collins et al., 1993). In the context of reproductive health, the more power women have, the more control they have over their own lives and a variety of "life options" including marriage, divorce, sexuality, and household authorities (Blumberg, 1984). Thus, women at higher status are more likely to use SBAs because they have greater power in determining where and with whom they will deliver.

Figure 4.1. An Integrated conceptual framework on SBA use in Africa (Same as Figure 2.2)



As illustrated in Figure 4.1, the positive relationship between women's education and SBA use is mediated by women's household decision-making power, perceptions of gender norms, and age at first marriage. Particularly, women's education is positively associated with each of these empowerment measures, which in turn positively affect SBA use at childbirth. The intervening effect of empowerment and its influences on reproductive health behaviors and outcomes has been documented theoretically and empirically (Blumberg, 1984; Malhotra et al., 2002); however, these pathways are rarely tested statistically (e.g., using mediation analysis). Specifically, women of higher status are more likely to use SBA because: 1) they are married at older ages; 2) their decision-making power is higher; and 3) their perceptions of gender norms are more progressive (e.g., they do not accept gender violence by husbands, and perceive the ability to negotiate sexual relations with husbands).

The proxy measures of women's empowerment indicated in Figure 4.1 reflect the multidimensionality of empowerment and the importance of examining the direct and indirect effects of women's status and empowerment on reproductive health outcomes. Furthermore, this framework considers the potential confounding effects of sociodemographic characteristics of women and households, as well as perceived difficulty in accessing health care, on the relationship between women's education and SBA use (Thaddeus&Maine, 1994).

***Study Settings – Senegal and Tanzania***

This study investigated the use of SBAs in two countries in different regions in Africa – Senegal (SN) and Tanzania (TZ). The two countries have similarities in several key heath indicators, yet they are culturally and economically distinct. Their differences – which are influenced by their colonial, administrative, political histories, sociocultural environment, and health systems – make them useful cases to compare. Reproductive and child health indicators are similar across the two countries – Total Fertility Rates are 5.0 in SN and 5.4 in TZ, and Infant Mortality Rates are 50 per 1,000 births in both countries (NBS Tanzania& Macro, 2012; ANSD Senegal&Macro, 2012).

Although the latest MMRs in 2010 (370 per 100,000 in SN, 460 in TZ) are similar between the two countries, there are differences in the availability and use of maternal health care services. More than two-thirds of the recent births in the last five years occurred at health facilities (72.8%) in Senegal, as compared to half (50.2%) in Tanzania (NBS Tanzania&Macro, 2012; ANSD Senegal&Macro, 2012). Furthermore, there are more health facilities (in terms of density per population) in Tanzania, but relatively fewer health professionals available than in Senegal (WHO, 2010, 2014; Tanzania ministries of health&WHO, 2007).

Although traditional customs have historically limited women's activities outside the household (Croll, 1981) in Tanzania, more recent shifts in sociocultural traditions and norms

(e.g., arranged marriage, dowry, and polygamy) are likely to positively influence women's status and empowerment, and subsequently reproductive health behaviors and service use (McCloskey et al., 2005; Lausen&Hollos, 2003). Likewise, the gradual rise in Senegalese women's participation in socioeconomic and political activities has been shown to be positively related to women's empowerment (e.g., socioeconomic and political power, and freedom of mobility) and delivery care use (Sieveking, 2007; Patterson, 2002), although there is evidence of persistent barriers in maternal health service use due to women's low status in society (Faye, 2008, 2010). Given these varied influences and persistent barriers to reductions in maternal mortality in both of these countries, it is important to identify and examine the disparate determinants and mechanisms linking women's status and empowerment to delivery care use and how these mechanisms may differ between unique sociocultural and historical contexts.

## 4.4. Methods

### (1) Data and Sample

This study employed the 2010-11 Senegal and 2010 Tanzania Demographic and Health Survey (DHS) datasets, nationally representative household surveys that collected data on a variety of population, health, and nutrition issues. The study sample consisted of all births reported by currently married women that occurred in the five years preceding each

survey. The total number of women who gave birth during this period was 8,146 (unweighted) in Senegal and 5,349 in Tanzania. Questions on decision-making power were asked to married women only, thus unmarried women were dropped from the analysis. Furthermore, a few women were dropped for missing data on the decision-making questions (n=11 in TZ) and the perceptions of gender norms questions (n=119 in SN and 82 in TZ), yielding a final study sample of 7,033 women (weighted) and 7,451(unweighted) in Senegal, and 4,445 women (weighted) and 4,409 (unweighted) in Tanzania. The proportion of all these missing observations is marginal – 1.6% over the potential female sample in Senegal and 2.1% in Tanzania (1.5 % over the potential birth sample in SN and 2.0 % in TZ) – thus, the potential bias due to missing is negligible. The total number of births to these women was 10,668 (weighted) and 11,431 (unweighted) in Senegal, and 6,748 (weighted) and 6,756 (unweighted) in Tanzania, after excluding births with missing delivery assistance information (n=4 in SN, 24 in TZ). The weighted mean number of births per woman is 1.517 (ranges 1-5) in Senegal and 1.524 (ranges 1-6) in Tanzania, respectively.

**(2) Variables/Measures**

***Dependent Variable***

***SBA use*** at childbirth was operationalized as the use of an SBA at childbirth(s) in the five years preceding the survey. The variable was recoded as binary, in accordance with the

WHO definition of SBAs (WHO, 2004). The SBAs included doctor or assistant medical officer, clinical officer, nurse or midwife; non-SBAs included MCH aide, village health worker, Traditional Birth Attendant, relative or friend, other, or no-one at the delivery.

### *Main Independent Variable*

***Women's education*** served as a proxy measure of women's status in this analysis. Education in single years was calculated based on the highest education level attended (e.g., primary, secondary) and the last grade at that level.

### *Potential Mediators – Women's Empowerment Measures*

The underlying structure of women's empowerment was determined according to the factor analysis results (See Results for detail) indicating four distinct dimensions: Household decision-making power, perceptions of gender norms against violence, perceptions for sex negotiation, and age at first marriage.

***Household decision-making power*** was examined as a summative variable. The survey asked women about their participation in decisions regarding household matters, specifically their ability to decide on their own health care, major household purchases and visits to family or relatives. The variables were first recoded into binary to examine if the respondent participated in the decision (i.e., either alone or jointly with their husband/family)

or not. A summative variable captured the number of decisions in which women participated (scored 0-3).

***Perceptions of gender norms*** were examined across two domains: **perceptions against violence** and **perceptions for sex negotiation**. The survey asked about women's acceptance of wife-beating by her husband under five situations – if she goes out without telling him, neglects the children, argues with him, refuses to have sex with him, or burns the food. The variables were first recoded as binary (i.e., yes or no). A summative variable captured the number of situations in which women do NOT accept the violence (scored 0-5), with higher numbers indicating lower acceptance of gender violence and more progressive gender norms. Also, the survey asked about women's perceived ability to negotiate sexual relations – if the respondent can refuse having sex or can ask her partner to use a condom. The variables were recoded to determine if she can refuse/ask or not (i.e., cannot refuse/ask, don't know, not sure, or depends). A summative variable captures the number of aspects with which women think that they can negotiate with their husband (scored 0-2).

***Age at first marriage*** was examined as a continuous variable that was calculated based on the date of the first marriage or union (phrased in the survey as "living with a man as if married") and the date of birth of the respondent.

### *Control Variables*

***Sociodemographic characteristics of women and households*** included women's age, parity, employment for payment, household wealth, marital and household relationship, the gender composition of children, and the place of residence. Women's age and parity (i.e., the birth order of the children) at the time of delivery were examined as continuous variables based on preliminary analyses indicating linear relationships with SBA use. Employment for payment was a binary measure defined as a woman who had been employed for cash or in-kind in the last 12 months, or not. Household wealth was examined using household asset data, such as ownership of consumer items and home attributes. Principal component analysis was conducted by MEASURE DHS to develop a ranking of household wealth according to the scores, and households were then divided into quintiles (NBS Tanzania and Macro, 2011). Marital relationship was assessed as categorical – monogamous union, polygamous as a first wife, or polygamous as a second wife or lower – to examine the potential differences by the type of relationship and wife order. Household relationship was assessed as binary – if the respondent was a household head or not. The gender composition of children, a binary variable, was examined if the respondent had at least one living son or not at the time of the delivery, considering the traditional value or preference for son that can reflect women's status and power in Africa (Fuse, 2008). Place of residence indicated if the respondent lived in an urban or rural area. These control variables were available in both countries. Although

other important variables (e.g., religion and ethnicity) were also assessed in separate analyses, they are not presented in the final models since they were not available in Tanzania.

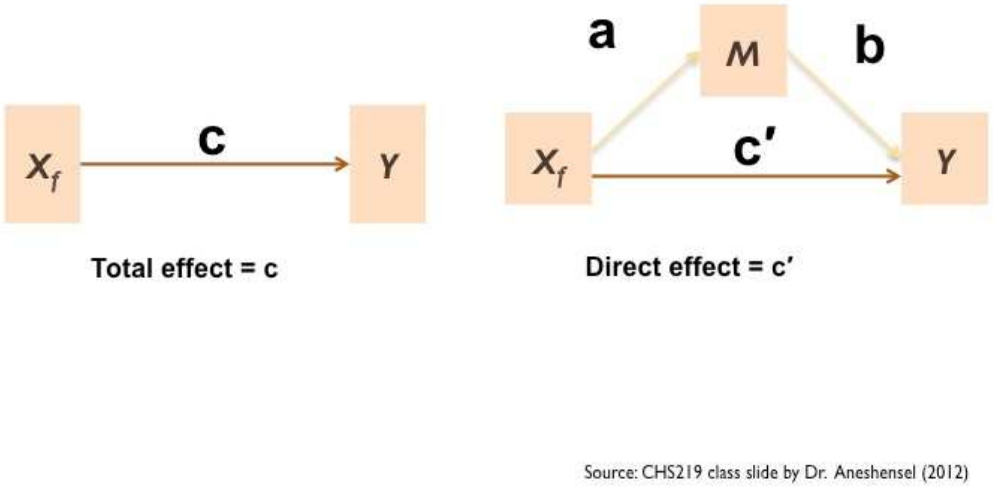
***Perceived difficulty in accessing health care*** was also included as a control variable, which assessed if the respondent perceives difficulty when seeking health care. The questions included: getting permission to go; getting money needed for advice/treatment; the distance to the healthy facility; or not wanting to go alone. The variables were first recoded into binary variables to show if the respondent perceived a big problem or not (i.e., not a big problem or not a problem at all), then recoded into a summative scale (scored 0-4), with higher scores indicating higher perceived difficulties.

**(3) Analytic Strategies**

Data analysis was conducted in four main steps. First, descriptive analyses were conducted using SAS 9.3 to assess the distribution of and to describe the variables. Second, factor analyses were conducted using Mplus 7.11. Exploratory Factor Analysis (EFA) identified the underlying structure of empowerment among the related study indicators based on a geomin rotation, an oblique type of rotation that assumes the correlations among factors and factor loadings of each indicator, according to the cutoff point for Eigenvalues <1.0 (Pett, 2003). Confirmatory Factor Analysis (CFA) was then employed to assess the appropriateness of the identified factor structure.

Third, sequential regression analyses were conducted, according to the elaboration model approach. This is an explanatory model to determine if an empirical association between the focal independent and dependent variables potentially involves a causal connection (Rosenberg, 1968; Aneshensel, 2013). Multivariate logistic regression analyses were conducted for the SBA use, and multiple linear regression models were used for the empowerment-related continuous variables. The effect of education on the potential mediators (expressed as "a"), the effects of each mediator on SBA use (as "b"), the total effect of education on SBA use (as "c"), and the net direct effect of education on SBA use (as "c' – prime c") were estimated (Figure 4.2).

Figure 4.2. Diagrams for the concept of mediation analysis (Same as Figure 2.3)




Source: CHS219 class slide by Dr. Aneshensel (2012)

The regression models were built in four steps. First, an unadjusted model was fit to examine the focal relationship between SBA use and education. Bivariate associations were also tested between SBA use and each of the explanatory variables in the model. Second, SBA use was then regressed on education, controlling for sociodemographic characteristics of women and households, as well as perceived accessibility of health care. Third, each of the potential mediators – proxies of women's empowerment – was regressed on education and the sociodemographic control variables. Last, SBA use was then regressed on education, and all the control variables and the empowerment measures. Multicollinearity was assessed using variance inflation factors and shown to be below cut-off point of 10, indicating minimal multicollinearity.

Consequently, the mediation effects were calculated from the product of coefficient tests (i.e., the multiplicative of "a" and "b") that calculate the mediating effect by multiplying the effect of the main independent variable (e.g., education) on the mediator (e.g., power) and the effect of the mediator on the dependent variable (e.g., SBA use).[3] Sobel tests were conducted to assess the statistical significance of mediation effects for formally assessing the mediation. These tests examined whether the indirect effect of the main independent variable (e.g., education) on the dependent variable (e.g., SBA use) via the mediator (e.g., women's

[3] The difference in coefficients tests (i.e., "c" subtracted by "c' – prime c") were also considered. However, for mediation analysis of categorical dependent variable, the difference in coefficients tests are not correct unless model parameters are standardized (MacKinnon, 2008). Thus the product of coefficient tests are more accurate and not susceptible to the scaling problem (MacKinnon, 2008).

power) is significantly different from zero. The mediation effects were calculated as the proportion of the indirect effect (i.e., the multiplicative of "a" and "b") relative to the direct effect (i.e., "c' – prime c") (MacKinnon, 2008; Aneshensel, 2013).

All the analyses were conducted accounting for individual weights, clusters (i.e., Primary Sampling Unit), and sample strata using the survey analysis commands. Given that the study examined births occurring to women nested in households, the analysis corrected the standard errors for clustering by woman and household using the Taylor Series linearization method (Williams, 2000). Model fit was assessed through Likelihood Ratio (LR) chi-square test and Wald chi-square test for multivariate logistic regression; and F-statistics, Root Mean Square Error (MSE), R-square for multiple linear regression.

## 4.5. Results

### (1) Descriptive

The descriptive results are shown in Table 4.1. Just over half of the respondents used SBA at the last birth (50.9%) in Tanzania, as compared to two-thirds of women in Senegal (66.3%).[4] In general, the women's status and empowerment variables show higher levels for women in Tanzania relative to Senegal, with the exception of age at first marriage. Tanzanian

[4] Almost half of the female study sample (3,657 in SN, 2,271 in TZ) had multiple births in the five years preceding the survey. The proportion of SBA use for all births is similar to the proportion of SBA use for the most recent births (64.6% in SN, 47.5% in TZ).

women participated in more household decision-making than Senegalese women (Mean score 0.92 out of 3 in SN; 1.43 in TZ). Similarly, women in Tanzania reported more cases in which gender violence was not justified, (Mean 2.80 out of 5 in SN; 3.16 in TZ), and reported higher perceived levels of negotiation in their sexual relationships (Mean 0.60 out of 2 in SN; 1.38 in TZ) as compared to women in Senegal. Women got married or started a union in their teenage years with the same mean age between the two countries (Mean 18.3 years in SN and TZ). Women in Tanzania had higher levels of education, parity, and were more likely to be in monogamous unions, while women in Senegal were far more likely to live in urban areas.

**(2) Factor Analysis**

EFA results indicated that the construct of women's empowerment is comprised of the following three factors: 1) household decision-making power (three indicators); 2) perceptions of gender norms against violence (five indicators); and 3) perceptions of gender norms for sex negotiation (two indicators) in both Senegal and Tanzania (See Table 4.2). A preliminary EFA showed that age at first marriage had very low loadings (e.g., less than 0.2) on all of the identified factors, suggesting that this is a separate dimension from the others. CFA results confirmed this structure. The correlations among these identified three factors are low (<0.313 in SN; <0.252 in TZ), thus each of them is likely to be distinct and can have independent and possibly disparate influences on SBA use.

**(3) Regression Results**

Table 4.3 shows the results of the sequential regression analyses. After fitting the simple logistic models to estimate the unadjusted odds of using an SBA at childbirth (i.e., bivariate association) (Model 1), adjusted multivariate logistic regression models predicted the odds of using an SBA (i.e., the total effect of education) (Model 2), and the net direct effect of education and the effect of respective potential mediators (i.e., empowerment measures) on SBA use in the final full model (Model 3). Multiple linear regression models estimated the effects of education on each of the potential mediators: age at first marriage, decision-making power, and perceptions of gender norms against violence and for sex negotiation (summary shown in Table 4.4). Model fit statistics show that all the models fit the data well ($p<0.001$).

The bivariate relationships were first examined between SBA use and each of the explanatory variables (Columns 1&4 in Table 4.3). Women's education is significantly and positively related to SBA use both in Senegal and Tanzania. Most of the explanatory variables show statistically significant associations with SBA use, with the exceptions of age at delivery and employment for payment in Senegal, and household headship in Tanzania.

The total effect of education on SBA use, that is the sum of the direct and indirect effect (expressed as "c"), is statistically significant in both countries – women's education is positively associated with SBA use, even after adjusting for sociodemographic characteristics

of women and households and perceived difficulty in accessing health care (Columns 2 and 5 in Table 4.3). A one-year increase in formal education is associated with 6.4% higher odds of using SBA in Tanzania, and 3.2% higher odds in Senegal.

However, the net direct effect of education on SBA use (expressed as "c' (prime c)") shows variations between the two settings (Column 3 and 6 in Table 4.3). The net direct effect of education (i.e., after adjusting for control variables and all potential mediators) on SBA use is statistically significant in Tanzania, but not in Senegal. In the fully adjusted models, a one-year increase in formal education is associated with 5.8% higher odds of using SBA in Tanzania. The influences of sociodemographic variables on SBA use are similar in both settings, with the exception of employment for payment. Age at delivery, household wealth, and urban residence are all positively related to SBA use, while parity, polygamous union, and having son(s) are negatively related in both countries.

As a next step, multiple linear regression models were conducted to estimate the effect of education on women's empowerment measures (expressed as "a" in Table 4.4). The models regressed each of the empowerment measures on education and other sociodemographic characteristics; the results show almost the same conclusions between two countries. In all of the models, women's education is significantly and positively associated with each of the four proxy measures of empowerment in both Senegal and Tanzania (Table 4.4).

The fully adjusted multivariate logistic regression models also estimated the effect of each proxy measure of empowerment on SBA use (Column 3 and 6 in Table 4.3; also expressed as "b" in Table 4.4). The results show varied associations by country and measure. In Tanzania, decision-making power shows a significant positive association with SBA use, while perceptions of gender norms for sex negotiation are only at borderline significance and the other proxies are not significant. Yet in Senegal, perceptions of gender norms against violence and for sex negotiation show significant positive associations, while age at first marriage is of borderline significant, and decision-making power is not significant. Among Tanzanian women, each additional household decision in which women participate is associated with 12% higher odds of using an SBA. In Senegal, for each additional situation in which women do not justify domestic violence, or in which women perceive their ability to negotiate sex, there is an 8.8% and 15.1% higher odds of using an SBA, respectively.

**(4) Mediation Analysis Results**

As a next step, Sobel tests were conducted to assess the indirect effects of education on SBA use through the potential mediators, and the product of coefficient test was conducted to estimate the odds of SBA use as indirectly influenced by education. The effect of each potential mediator – that is each dimension of empowerment – was assessed as the net mediating effect, accounting for the other potential mediators. Coefficients were derived

from the regression analysis (Table 4.3 and 4.4), specifically the effect of education on mediators (=a) and the effect of mediators on SBA use (=b).

In Tanzania, the mediation effect of decision-making power is statistically significant, and the perceptions of gender norms for sex negotiation are at borderline significance (Table 4.5). As noted in the mediation tests in the table, there is a statistically significant indirect association between education and SBA use through decision-making power (OR=1.0029), accounting for just over 5% relative to the direct effect of education on SBA use. There are no other significant mediation effects for the other potential mediators: age at first marriage, perceptions against violence, and perceptions regarding sex negotiation.

On the other hand, in Senegal, both perceptions of gender norms domains – against violence and for sex negotiation – significantly mediate the relationship between education and SBA use. Decision-making power is not a significant mediator, and age at first marriage reached only borderline significance. A one year increase in formal education is indirectly associated with 0.59 % higher odds of using SBA though perceptions of gender norm against violence and 0.55% higher odds through perceptions for sex negotiation, and the proportions of these mediation effects are substantial (35.28% and 32.58% relative to the direct effect of education on SBA use, respectively). Thus in Senegal, findings from the mediation analyses indicate a substantial mediation effect of gender norm perceptions in the relationship between education and SBA use.

## 4.6. Discussion

This study examined the multidimensional and mediation effects of women's empowerment measures on SBA use at childbirth in two African countries – Senegal and Tanzania, finding the unique influence of empowerment by dimension and country. This contrasting case study provided evidence of the direct and indirect effects of education on SBA use through multiple empowerment dimensions –household decision-making power, perceptions of gender norms, and age at first marriage. The results also confirmed that women's empowerment is comprised of multiple dimensions that are likely to vary across study settings and have disparate influences on health care use such as delivery care.

This analysis highlighted three, key contrasts between the two countries with respect to the composition of and effects of women's empowerment on SBA use. First, the net direct effect of education was significant and positive in Tanzania, yet it was not significant in Senegal. This suggests that women's *formal* education may not be the most relevant measure of "women's status" nor predictor of women's maternal and reproductive health across all settings. Despite evidence that women's formal education is positively associated with maternal health care use and delivery outcomes (Koblinsky, et al., 2006; Thaddeus&Maine, 1994), participation in formal education may not be the best measure of women's education and/or status in settings where there are low levels of formal education, such as Senegal, in which formal education attendance of women was less than two years on average. Although

the rarity of formal education could lead to higher social standing of such women, in several West African countries, informal education (e.g., Islamic schools and education) is common and recognized, and may not be associated with women's status in the same way that formal education is. Indeed, in Senegal, the effect of education on SBA use is not significant after controlling for sociodemographic variables and women's empowerment measures. This may suggest that some of these sociodemographic variables may be more influential than formal education status on maternal and reproductive health outcomes.

Second, the findings suggest that women's education positively affects proxy measures of women's empowerment, which in turn positively affect SBA use. This mechanism has been supported by the gender theories and the integrated conceptual framework of this study (Blumberg, 1984; Collins et al., 1993). This analysis showed that the positive influence of education on each of the empowerment measures is relatively similar in both settings. However, the variation of mediating effects of empowerment measures between the two countries suggests that the indirect effect of education through empowerment measures differs across these settings. For example, substantial influences of perceptions of gender norms in Senegal, as a direct and mediating factor for SBA use, may be partly explained by permissive gender norms in their sociocultural context in general.

Third, the mediating effect of women's empowerment measures, as well as their direct effect on SBA use, show clear contrasts across measures and countries. For example,

perceptions of gender norms against violence and for sex negotiation offers an indication why women with higher education are more likely to use SBA in Senegal, whereas in Tanzania, household decision-making power is a critical mediator. Additionally, in terms of the direct effect, only one empowerment measure – perceptions of gender norms for sex negotiation – appear to positively influence SBA use in both settings, while the influence of all other measures are disparate between the two countries.

These variations of the influence of empowerment may suggest different components and implications of women's empowerment by setting. Particularly, diverse sociocultural contexts may partly explain the varied implication of empowerment between these countries. Indeed a separate analysis has found that the influence of sociodemographic characteristics of women and households on empowerment measures is different across these countries and measures (e.g., employment) (See sensitivity analysis 2.9.3, Table 2.14&2.15, Page 115-116). The comparison of two countries under distinct sociocultural contexts illuminated the importance of comparative case studies in examining disparate influences and mechanisms affecting delivery care use, and cautions against the use of uniform measures and operationalizations across countries, as well as assuming similar implications on health outcomes from one setting to another. Although the DHS measures provide an opportunity to compare these measures across diverse settings, subsequent research that identifies local definitions of women's empowerment and can augment these standard measures is still

needed (Upadhyay et al., 2014). Yet researchers can better utilize the existing measures in the DHS or elsewhere by conducting an appropriate preliminary analysis to identify the most appropriate operationalization in a given context.

This study entails some limitations despite addressing several research gaps. First, this study employed cross-sectional survey datasets, thus any causal inference is tentative. The direction of causation cannot be inferred due to potential reciprocal effects, despite relevant theories that support the causal relationship according to the employed conceptual framework (Blumberg, 1984; Collins et al., 1993). In order to examine the effect of empowerment as a process, it should be examined over time ideally using longitudinal data. Due to the differences in survey sampling and weighting across the two contexts, it was not possible to test for statistically significant differences between the two settings. Additionally, the logistic regression models do not allow direct comparisons of estimated odds across models (Mood, 2010). Despite this limitation, this preliminary comparative analysis demonstrated a clear contrast between the two countries and differences of the predicted odds of using SBAs.

Second, the operationalization and measurement of women's status and power is limited to the measures that are available in the DHS surveys. In accordance with the debate on the relevance of household decision-making participation questions, which were developed based on the Asian context (Kishor&Subaiya, 2008), there may be other or

additional measures that are more relevant for Sub-Saharan Africa. Indeed, in Senegal, women do not commonly participate in household decision-making, and it is not significantly associated with SBA use. The mixed findings of empowerment measures across different study settings are consistent with the evidence from other cross-African studies (Singh et al., 2011; Woldemicael, 2010). This also highlights the importance of examining each of the measures approximating empowerment independently, as well as to identify the structure of empowerment dimensions and their relationships using statistical analysis such as factor analysis.

Third, since the decision-making questions are only administered to currently married women, unmarried women and adolescents are not represented. In addition to limiting the generalizability of these findings to married women, it also highlights the need for future research to consider questions – as they pertain to decision-making and other empowerment domains – that are relevant regardless of marital status. The omission of adolescents is notable, especially amidst growing evidence that adolescents, especially ages 10-14, are at greater risk of delivery without skilled professionals, unsafe abortion, and maternal deaths (WHO, 2011; Bearinger et al., 2007; Magadi et al., 2007; Neal et al., 2012; Wellings et al., 2006; Pandey et al., 2011) and findings from this study confirming the negative influence of younger age at childbearing on SBA use.

Two important sociocultural aspects (e.g., religion, ethnicity) were omitted from this analysis as these data were not available for Tanzania. Separate analyses were conducted with the Senegal data to test the independent effects of religion and ethnicity. However, the conclusions from the regression and mediation analyses did not change, supporting the evidence from this analysis despite these important omitted variables.

Last, although the mediation effect could have also been examined using other robust approaches and techniques (e.g., bootstrapping, structural equation modeling), none of the currently available software conduct bootstrapping with survey data, and this analysis provides a simplified examination of the implicit pathways without need for additional software or more complex statistical techniques. Moreover, separate analyses conducted using SEM (See Chapter five, Page 206) showed the same conclusions, supporting the relevance of this findings.

Despite these caveats, this study is one of the few theory-based studies that examined the intervening effects of women's empowerment in the pathway between women's status and SBA use. This study provides evidence of these potential causal pathways, confirming the multidimensional and contextual nature of women's empowerment in two distinct African countries. This evidence illuminates the disperse pathways affecting SBA use across settings, and highlights the need of culturally and contextually tailored policies and program

interventions to uplift women's status and empowerment, in an effort to promote SBA use and accelerate maternal mortality reduction.

**Table 4.1. Characteristics of participating, currently married women with at least one birth in last 5 years (weighted n=7,033 in SN; n=4,445 in TZ), Senegal and Tanzania Demographic and Health Surveys (DHS) 2010**

| Variables | Senegal | | | Tanzania | | |
|---|---|---|---|---|---|---|
| | Freq | Weighted | | Freq | Weighted | |
| | | Mean or Proportion | SE | | Mean or Proportion | SE |
| **Outcome** | | | | | | |
| Skilled Birth Attendant (SBA) use at the last birth | 4,251 | 66.30 | 1.27 | 2,233 | 50.95 | 1.51 |
| **Women's empowerment proxy measures** | | | | | | |
| Age at first marriage | | 18.29 | 0.10 | | 18.28 | 0.06 |
| Decision-making power (scored 0-3) | | 0.92 | 0.03 | | 1.43 | 0.02 |
| Gender norms against violence (0-5) | | 2.80 | 0.05 | | 3.16 | 0.04 |
| Gender norms for sex negotiation (0-2) | | 0.60 | 0.02 | | 1.38 | 0.02 |
| **Demographics and perceived accessibility of health care** | | | | | | |
| Education | | | | | | |
| Formal education attendance (in years) | | 1.79 | 0.08 | | 5.01 | 0.10 |
| No formal education | 5,577 | 70.54 | 1.21 | 1,082 | 24.42 | 1.22 |
| Primary attended | 1,384 | 20.74 | 1.01 | 2,771 | 68.93 | 1.18 |
| Secondary or above | 490 | 8.71 | 0.57 | 556 | 6.65 | 0.52 |
| Current age | | 29.40 | 0.12 | | 29.38 | 0.15 |
| Household wealth quintile | | | | | | |
| Poorest | 2,264 | 22.38 | 1.31 | 818 | 19.58 | 1.08 |
| Poorer | 1,882 | 20.95 | 1.18 | 957 | 22.61 | 0.96 |
| Middle | 1,534 | 19.19 | 1.13 | 905 | 21.47 | 0.92 |
| Richer | 1,056 | 19.85 | 1.34 | 954 | 19.99 | 1.12 |
| Richest | 715 | 17.63 | 1.12 | 775 | 16.35 | 1.14 |
| Employment for payment | | | | | | |
| Employed (currently or last 12 months) | 3,386 | 46.04 | 1.12 | 1,717 | 38.07 | 1.10 |
| Parity (Total # of children ever born to women) | | 3.81 | 0.04 | | 3.90 | 0.05 |
| Marital relationships | | | | | | |
| Monogamous union | 4,909 | 68.19 | 0.83 | 3,394 | 78.87 | 0.53 |
| Polygamous as 1st wife | 991 | 12.73 | 0.44 | 434 | 8.97 | 0.53 |
| Polygamous as 2nd or lower | 1,550 | 19.08 | 0.55 | 549 | 12.16 | 0.82 |
| Household head | 322 | 4.98 | 0.38 | 251 | 5.67 | 0.47 |
| Place of residence | | | | | | |
| Urban | 2,267 | 39.95 | 1.62 | 878 | 21.67 | 1.18 |
| Rural | 5,184 | 60.05 | 1.62 | 3,531 | 78.33 | 1.18 |
| Perceived difficulty in accessing health care (Mean, scored 0-5) | | 1.23 | 0.04 | | 0.53 | 0.02 |

Note: Characteristics related to births were also assessed including all births that these women delivered in the last five years (weighted birth n=10,668 in SN; n=6,748 in TZ). The proportion of SBA use at the recent birth(s) was 64.6% in SN; 47.5% in TZ. The mean of birth order of each birth was 3.67 in SN. Birth order of each birth was 3.67 in SN; 3.75 in TZ. The proportion of births that took place when women had living son(s) was 60.2% in SN; 62.3% in TZ.

Frequency missing with demographic characteristics=32 (with marital relationships), and 17 (with perceived difficulty in accessing health care) in Tanzania. Missing=1 (with marital relationships) in Senegal.

**Table 4.2. Factor analysis for indicators of empowerment (weighted n=7,033 in Senegal; 4,445 in Tanzania), Demographic and Health Survey (DHS) 2010**

| *Latent construct* | *Indicator* | *Aspects that survey asked* | *Factor loadings* | |
|---|---|---|---|---|
| | | | *Senegal* | *Tanzania* |
| Household decision-making | Hlt | Decision on own health care | 0.916* | 0.795* |
| | Purc | Decision on major household purchases | 0.869* | 0.865* |
| | Visit | Decision on visits to family or relatives | 0.851* | 0.939* |
| Perceptions of gender norms against violence | Gout | Violence if going out without telling husband | 0.917* | 0.890* |
| | Negl | Violence if neglects the children | 0.933* | 0.922* |
| | Argue | Violence if argues with him | 0.963* | 0.929* |
| | Refs | Violence if refuses to have sex with him | 0.911* | 0.883* |
| | Burnf | Violence if burns the food | 0.822* | 0.863* |
| Gender norms for sex negotiation | Negsex | Perceived ability in refusing sex | 0.803* | 0.844* |
| | Negcon | Perceived ability in asking condom use | 0.771* | 0.693* |

Note: Factor loadings from the three factor models are presented. p<.05*.
Model fit statistics: [EFA for Senegal] RMSEA=0.034, CFI=0.996, TLI=0.989, SRMS=0.013;
[EFA for Tanzania] RMSEA=0.036, CFI=0.996, TLI=0.989, SRMS=0.018.

**Table 4.3. Bivariate and multivariate logistic regression analyses of skilled birth attendant use for births occurring in last 5 years (weighted n=6,748 in TZ, n=10,668 in SN), Demographic and Health Survey (TDHS) 2010**

| Variables | | Tanzania | | | Senegal | | |
|---|---|---|---|---|---|---|---|
| | | [Column 1] Model1 unadjusted | [Column 2] Model2 adjusted | [Column 3] Model3 full model | [Column 4] Model1 unadjusted | [Column 5] Model2 Adjusted | [Column 6] Model3 full model |
| | | OR | OR | OR | OR | OR | OR |
| **Focal independent** | Education in years | 1.167*** | 1.064*** | 1.058*** | 1.243*** | 1.032* | 1.017 |
| **Control variables** | | | | | | | |
| Age at childbirth | | 0.986** | 1.076*** | 1.075*** | 1.003 | 1.041*** | 1.028** |
| Household wealth | Poorer | 1.169*** | 1.026 | 1.024 | 2.476*** | 2.228*** | 2.158*** |
| (Ref.=Poorest) | Middle | 1.844*** | 1.520*** | 1.529*** | 6.927*** | 4.348*** | 4.163*** |
| | Richer | 3.612** | 2.090*** | 2.132*** | 17.985 | 7.164*** | 6.519*** |
| | Richest | 21.612*** | 5.668*** | 5.553*** | 52.422*** | 16.717*** | 14.814*** |
| Parity (# children ever born) | | 0.849*** | 0.788*** | 0.787*** | 0.857*** | 0.888*** | 0.915** |
| Employment for payment | (Ref.= Not employed) | 2.163*** | 1.196* | 1.166 | 1.095 | 0.795*** | 0.799*** |
| Household head | (Ref.= Not household head) | 0.836 | 1.159 | 1.096 | 1.693*** | 1.154 | 1.140 |
| Urban residence | (Ref.=Rural) | 7.305*** | 2.160*** | 2.160*** | 10.066*** | 3.002*** | 2.836*** |
| Marital relationship | Polygamous as 1st wife | 0.401*** | 0.556*** | 0.568*** | 0.630** | 0.792* | 0.819* |
| (Ref.=Monogamous) | Polygamous as 2nd or lower | 0.560 | 0.638*** | 0.671** | 0.648** | 0.729*** | 0.760*** |
| Having son(s) | | 0.550*** | 0.768** | 0.757** | 0.565*** | 0.751*** | 0.744*** |
| Perceived accessibility of health care | | 0.607 *** | 0.607 *** | 0.739*** | 0.655*** | 0.866*** | 0.867*** |
| **Women's empowerment proxy measures** | | | | | | | |
| Age at first marriage | | 1.102*** | | 0.994 | 1.131*** | | 1.018† |
| Participation in household decision making (scored 0-3) | | 1.208*** | | 1.120*** | 1.229*** | | 1.025 |
| Perceptions against violence (0-5) | | 1.112*** | | 1.015 | 1.306*** | | 1.088*** |
| Perceptions for sex negotiation (0-2) | | 1.376*** | | 1.096† | 1.508*** | | 1.151** |
| **Intercept** | | | -1.6281*** | -1.7852*** | | -0.886*** | -1.238*** |
| **Model statistics** | | | | | | | |
| LR (Chi-square) | | | 1662.979 | 1699.4359 | | 3660.6461 | 3736.8961 |
| Wald (Chi-square) | | | 702.7261 | 708.9709 | | 1292.9322 | 1311.3301 |
| DF | | | 14 | 18 | | 14 | 18 |
| P | | | *** | *** | | *** | *** |

Note: p<.001 ***, p<.01**, p<.05*, † = p<0.10. Model 1 (simple binary regression model) was assessed by each explanatory variable, and the model statistics of each model are not reported in the table. For the overall association, wald chi-square tests (from Type 3 Analysis of Effects) were assessed with wealth and marital relationship, showing significance at p<.001. For the intercept, coefficients are reported.

**Table 4.4. Summary of odds ratio and odds from regression analyses of empowerment and skilled birth attendant use for births occurring in last 5 years (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| **Key Coefficients**: | | | | | | |
|---|---|---|---|---|---|---|
| | **Tanzania** | | | **Senegal** | | |
| | OR | b (coefficient) | SE | OR | b (coefficient) | SE |
| ***1) The effect of education on mediators = a*** | | | | | | |
| Age at first marriage = a(m) | | 0.1337 *** | 0.0162 | | 0.1215 *** | 0.0193 |
| Decision-making power = a(d) | | 0.0253 *** | 0.0076 | | 0.0259 *** | 0.0076 |
| Perceptions against violence = a(v) | | 0.0274 * | 0.0125 | | 0.0703 *** | 0.0096 |
| Perceptions for sex negotiation = a(s) | | 0.0398 *** | 0.0051 | | 0.0389 *** | 0.0050 |
| ***2) The effect of mediators on SBA use = b*** | | | | | | |
| Age at first marriage = b(m) | 0.994 | -0.0057 | 0.0155 | 1.018 | 0.0183 | 0.0098 |
| Decision-making power = b(d) | 1.120*** | 0.1136 | 0.0338 | 1.025 | 0.0249 | 0.0287 |
| Perceptions against violence = b(v) | 1.015 | 0.0147 | 0.0218 | 1.088*** | 0.0843 | 0.0151 |
| Perceptions for sex negotiation = b(s) | 1.096 | 0.0915 | 0.0532 | 1.151** | 0.1406 | 0.0443 |
| ***3) The total effect of education on SBA use = c*** | | | | | | |
| | 1.064*** | 0.0616 | 0.0135 | 1.032* | 0.0316 | 0.015 |
| ***4) The net direct effect of education on SBA use = c'*** *(that is derived from the regression model including all of the potential mediators)* | | | | | | |
| | 1.058*** | 0.0561 | 0.0138 | 1.017 | 0.0168 | 0.0151 |

Note: p<0.05*, p<0.01**, p<0.001***.

For the effect of education on mediators (=a), the coefficients were estimated from OLS. For the rest (b, c, c'), OR and odds were estimated from the multivariate logistic regression (Table 4.3). The effect of mediators on SBA use (=b) is derived from Model 3[Column 3&6 in Table 4.3]; the total effect of education (=c) from Model 2 [Column 2&5]; the net direct effect of education (=c') from Model 3 [Column 3&6].

**Table 4.5. Mediation effect of proxies of empowerment (weighted n=6,748 in Tanzania; n=10,668 in Senegal), Demographic and Health Survey (DHS) 2010**

| Tested Mediators | Country | Product of coefficient tests (a*b) | OR (=exponentiated ab) | Size of the mediation effect (ab/c') | Sobel test statistic | SE |
|---|---|---|---|---|---|---|
| Age at first marriage | Tanzania | -0.0008 | 0.9992 | 1.36% | -0.3674 | 0.0021 |
| | Senegal | 0.0022 | 1.0022 | 13.23% | 1.7850† | 0.0012 |
| Decision-making power | Tanzania | 0.0029 | 1.0029 | 5.12% | 2.3596* | 0.0012 |
| | Senegal | 0.0006 | 1.0006 | 3.83% | 0.8410 | 0.0008 |
| Perceptions against violence | Tanzania | 0.0004 | 1.0004 | 0.72% | 0.6447 | 0.0006 |
| | Senegal | 0.0059 | 1.0059 | 35.28% | 4.4381*** | 0.0013 |
| Perceptions for sex negotiation | Tanzania | 0.0036 | 1.0036 | 6.49% | 1.6803† | 0.0022 |
| | Senegal | 0.0055 | 1.0055 | 32.58% | 2.9414** | 0.0019 |

Note: p<0.001***, p<0.01**, p<0.05*, † = p<0.10.

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# Chapter 5

## Investigating Pathways Linking Women's Status and Empowerment to Skilled Birth Attendant Use in Tanzania: A Structural Equation Modeling Approach (Aim 3)

### 5.1. Introduction

Maternal mortality has declined worldwide, but it remains unacceptably high in low- and middle-income countries, where 99% of maternal deaths occur. In 2013, 289,000 women died from causes related to pregnancy and childbirth globally, most of which are preventable (WHO, 2014). Sub-Saharan Africa has some of the highest rates of maternal mortality in the world; the Maternal Mortality Ratio (MMR) (i.e., number of maternal deaths per 100,000 live births) in this region is 510. This number is more than twice as high as the global MMR of 210 (WHO, 2014). More strikingly, the lifetime risk of maternal death in sub-Saharan Africa (1 in 38) is much higher compared to the global average of 1 in 190 (WHO, 2014), and this disparity is far greater than that observed with child or neonatal mortality (Ronsmans et al., 2006).

Evidence indicates that survival for mothers and babies improves with professional care at childbirth provided by a Skilled Birth Attendant (SBA) (WHO, 2004). An SBA is defined as an accredited health professional – such as a midwife, doctor, or nurse – who is proficient in the skills needed to manage normal (uncomplicated) pregnancies, childbirth, and to identify, manage and refer complications in women and newborns (WHO, 2004). Use of an SBA at childbirth can potentially avert 16 to 33% of maternal deaths (Graham et al, 2001), and has been identified as the most effective contemporary programmatic approach globally. However, the proportion of births attended by SBAs continues to be low in sub-Saharan Africa where only half of deliveries are attended by an SBA (UN, 2014).

Although maternal mortality levels have declined globally, further reduction in maternal mortality rates has been thwarted by a complex set of factors at structural (e.g., country and society), community, household, and individual levels. Socioeconomic status (e.g., education and economy), physical distance to facilities, availability of transportation, and actual and perceived quality of care are predictive of delivery care use and outcomes (Shiffman, 2000; Koblinsky et al., 2006; Thaddeus and Maine, 1994).

Women's social status and power in deciding the type of care and provider have also been identified as critical factors influencing reproductive health care utilization including delivery care (i.e., SBA use, delivery at the facility) (Koblinsky et al., 2006; Malhotra, 2002; Thaddeus&Maine, 1994). In sub-Saharan Africa, women's social status and power are

comparatively lower than other regions of the world (Kishor&Subaiya, 2008), yet there are few studies that examine the linkages between women's empowerment and delivery care use and those that exist present inconsistent findings (Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010). Moreover, despite the complex and multidimensional nature of women's empowerment and its relationship to health outcomes, there is a need for an in-depth examination of the complex pathways and mechanisms by which women's status and empowerment may affect delivery care use.

This study uses Structural Equation Modeling (SEM) to address this persistent gap and to investigate the influence of multiple dimensions of empowerment on SBA use, in a complex mechanism involving multiple pathways and mediators in Tanzania.

## 5.2. Background

### *Women's status and empowerment*

Women's status and empowerment are terms that are commonly used in the literature to describe the social position of women and their ability to make decisions and take action related to their well-being (Malhotra et al., 2002; Kabeer, 2001). In general, ***women's status*** is defined as "women's overall position in the society", which encompasses their educational, cultural, economic, legal, and political position in a given society (Safilios-Rothschild, 1982;

Thaddeus&Maine, 1994). Women's ***power*** is defined as "women's ability to control or change other women's or men's behaviors and the ability to determine important events in their lives" (Safilios-Rothschild, 1982).

***Women's empowerment*** is the most frequently used term that describes women's position in society, and is defined as the *process* by which those who have been denied the ability to make strategic life choices acquire such ability (Kabeer, 2001). This concept encompasses three inter-related dimensions – resources (as pre-conditions), agency (as process), and achievements (as outcomes) – that comprise the ability to exercise choice (Kabeer, 2001).

Women's empowerment has been operationalized mostly through the use of proxy measures for "agency" and "resources" (Malhotra et al., 2002). For example, women's participation in decision-making on household matters is identified as "agency" by Kabeer (2001). Access to and control over resources (e.g., household income) reflect "resources", and social norms also determine "resources" (Kabeer, 2001). Specifically, several studies assess perceptions of gender norms, which mostly represent the relationship of women with their partners and the perceived equity in power and resources (Malhotra et al., 2002; Upadhyay et al., 2014). Early marriage and childbearing may be considered as women's major life strategic events, and thus reflect "achievements".

***Women's status, empowerment, and delivery care use***

Previous research generally finds a positive association between women's social status and empowerment measures, as well as between empowerment and the health of women and their families. Women's higher status and empowerment have generally been found to positively influence reproductive health behaviors (e.g., contraceptive use), fertility, child health/welfare, and women's health (Malhotra, et al. 2002; Upadhyay, et al. 2014). Although there are a few studies that have examined the effects of women's status (mostly operationalized as women's education) on delivery care use in Africa, there are fewer studies that incorporate measures of women's empowerment. Moreover, those that exist indicate contradictory findings.

In previous studies scholar mostly operationalized delivery care use as SBA use and/or facility delivery, which overlap and/or correlate, although they are different and can be independent (e.g., delivery assisted by SBAs in community). Women's status, especially education, shows a positive association. National-level studies using Demographic and Health Survey (DHS) datasets from Africa have generally found that education is positively related to delivery care use (Singh et al. 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011), whereas the influence of other sociodemographic characteristics of women and households is varied across countries (e.g.,

employment and household wealth). For example, women's employment is related to delivery care use in different directions – positively or negatively – across African countries (e.g., positively in Ethiopia, Eritrea, Liberia, Nigeria and Mali; negatively in Rwanda and Uganda) (Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008).

Although the positive influence of women's status and empowerment on reproductive health has been generally supported, the existing evidence of empowerment and delivery care use in sub-Saharan Africa does not provide a clear pattern. For example, proxies of empowerment including women's household decision-making participation are often not significantly related to delivery care use in studies in Africa (Singh et al., 2011; Woldemicael, 2010). A meta-analysis conducted with data from 35 countries shows a positive influence of household decision-making on SBA use (Ahmed et al., 2010), yet another multi-country study found a positive relationship between decision-making and facility delivery in Nigeria alone, and not in seven other African countries (e.g. Ghana, Mali, Uganda) (Singh et al., 2011). This relationship is not statistically significant also in some Asian studies (e.g., Bangladesh, Nepal, India) (Story&Burgard, 2012; Alendorf, 2007; Basu&Koolwal, 2005).

Additionally, few studies examined the multiple dimensions/aspects of empowerment in Africa, finding the disparate influence of each empowerment measure on delivery care use

by country. For example, education is consistently and positively related to facility delivery in all ten studied African countries; decision-making only in Eritrea and Nigeria; perceptions against violence in Ethiopia, Ghana, and Nigeria (Singh et al., 2011; Woldemical, 2010). Some African studies on fertility also demonstrate such disparate influences (Snow et al., 2013; Upadhyay&Karesak, 2010), suggesting the varied effect of each empowerment measure on reproductive health across countries.

Moreover, there are growing evidence and concerns for the negative effect of early childbearing on empowerment especially in Africa (Hindin, 2012), which in turn negatively influence reproductive health outcomes (WHO, 2011). Despite the fact that life strategic events including marriage and childbearing are identified as proxy measures of empowerment in some settings, their influence on delivery care use is not well studied in Africa. Thus, the mechanisms by which early marriage and/or childbearing influence decision-making power and perceptions of gender norms, and subsequently delivery care use, are not well understood.

***Methodological approaches***

This limited and inconsistent evidence is partly due to the methodologies employed in the literature. There are key three methodological challenges identified and to be

addressed in order to fill the persistent research gaps. First, inconsistent operationalizations and measurements of empowerment have complicated efforts to examine the influence of women's status and empowerment on reproductive health service use, including delivery care. Despite the empowerment definition (Kabeer, 2001) incorporating multiple dimensions, summative measures (e.g., single composite index/measure) are used in some studies, finding that each domain is related to contraceptive use differently by country (Do&Kurimoto, 2012). Thus such index may mask the implication and influence of specific dimensions/aspects comprising empowerment.

Second, as a consequence of the first challenge, only a handful of DHS studies on reproductive health in Africa explored the influence of multiple empowerment dimensions separately (e.g., gender norms against violence, for sex negotiation) or specific aspects/indicators (e.g., each decision-making indicator) (Woldermicael, 2010; Singh et al., 2010; Snow et al., 2013; Upadhyay&Karasek, 2010). A few studies conducted factor analysis to assess loadings in the pre-defined structure and/or dimensions of empowerment (Agarwala&Lynch 2006; Woldemicael&Tenkoranga, 2010; Pallitto&O'Campo, 2005; Do&Kurimoto, 2012). Yet none of these studies explored and defined the factor structure for multiple empowerment dimensions, and examined these dimensions as latent constructs (i.e., factors that several indicators reflect), as they relate to reproductive health behaviors and service use, including delivery care.

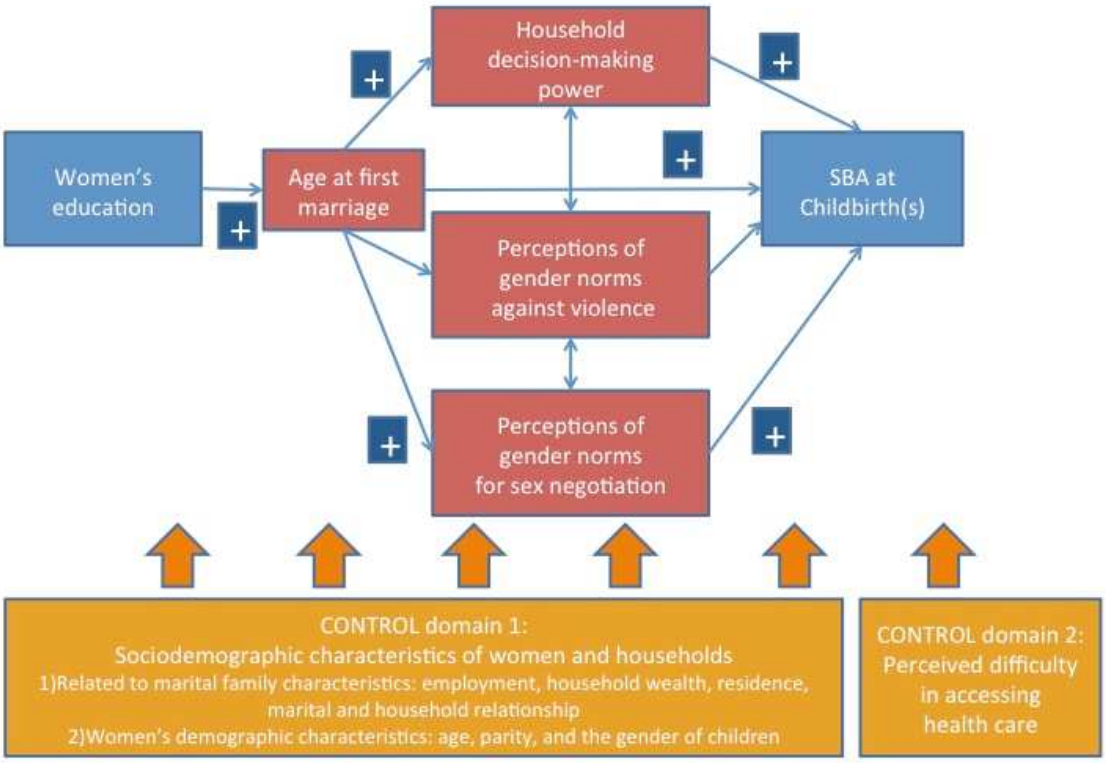
Third, despite the general understanding that the role of women's status and empowerment on delivery care use is complex, there is no clear evidence of these complex pathways and mechanisms in Africa. Such complex pathways and relationships have been assessed in recent health and behavioral researches using Structural Equation Modeling (SEM) (Chen&Yang, 2013; Kamp Dush, et al, 2013; Wang et al., 2013). A SEM is a useful approach when estimating complex relationships between multiple constructs, and as such, is rigorous for testing theories and examining potential causal mechanisms (Bollen&Noble, 2011; Kline, 2011). Yet a SEM has rarely been employed in research examining women's status, empowerment, and reproductive health. Although theory indicates empowerment as an intervening factor between women's status and reproductive health, none of the previous examination have statistically assessed the mediation effect of multiple empowerment dimensions and empirically tested the complex pathways linking women's status, women's empowerment and SBA use in SSA.

## 5.3. *Conceptual Framework and Hypotheses*

This analysis employed an integrated conceptual framework in reference to theory (Blumberg, 1984; Collins et al., 1993) to identify the underlying social issues that contribute to women's reluctance or inability to seek reproductive health services, resulting in negative health outcomes such as maternal mortality.

As shown in Figure 5.1, women's status, operationalized as women's education as a proxy, positively affects reproductive health service use, including SBA use. This relationship operates through women's decision-making power, perceptions of gender norms, and age at first marriage, according to gender theory suggesting these determinants and underlying sociocultural factors (Blumberg, 1984; Connell, 1987; Collins et al., 1993). In particular, the higher women's power, the higher their control over their own lives and their control over a variety of "life options" (e.g., marriage, divorce, sexuality, and household authorities) (Blumberg, 1984). Therefore, women at higher status are more likely to use SBA. Some studies on maternal and child health service use and outcomes in low-and middle-income countries have incorporated this theory, yet there is no study that has tested these complex pathways involving multiple empowerment measures as mediators and as latent constructs.

Figure 5.1. An Integrated conceptual framework on SBA (Same as Figure 2.1)




As illustrated in Figure 5.1, the positive relationship between women's education and SBA use is mediated by women's age at first marriage first, and then household decision-making power, and perceptions of gender norms. Specifically, the higher a woman's education, the older her age at first marriage, which lead to higher household decision-making power and more progressive perceptions of gender norms. Consequently, such women are more likely to use an SBA at childbirth.

These proxy measures of empowerment reflect the inherent multi-dimensionality of empowerment and the importance of examining the individual and potentially synergetic effects of empowerment on reproductive health behaviors and outcomes. Furthermore, this

framework considers the potential confounding effects of sociodemographic characteristics of women and households, as well as perceived difficulty in accessing health care, on the relationship between women's education and SBA use (Thaddeus&Maine, 1994).

Based on this conceptual framework, this study aimed to investigate the pathways between women's education and SBA use, through age at first marriage first, and then household decision-making power and perceptions of gender norms against violence and for sex negotiation in Tanzania. Structural Equation Modeling (SEM) was employed to examine multiple pathways and sequential mediators, to assess the relative contribution of each empowerment dimension on SBA use, and to compare the utility of the summative measure for each dimension and the latent construct (i.e., factor). Specifically, this complex mechanism and pathways were examined using five equations simultaneously to test the following hypotheses:

**Hypothesis 1**. Women's education, age at first marriage, household decision-making power, and progressive perceptions of gender norms (against violence and for sex negotiation) are positively related to SBA use.

**Hypothesis 2**. Women's education is positively related to the age at first marriage.

**Hypothesis 3**. Women's education and age at first marriage are positively related to household decision-making power.

**Hypothesis 4**. Women's education and age at first marriage are positively related to progressive perceptions of gender norms.

**Hypothesis 5**. The relationship between women's education and SBA use is mediated by age at first marriage first, and then household decision-making power and perceptions of gender norms.

## 5.4. Method

### (1) Study Setting and Data

This study examined the mechanism in which these multiple pathways lead to SBA use in the United Republic of Tanzania in East Africa. The MMR has declined by almost half in Tanzania in the last two decades (47% reduction from 870 to 460 per 100,000 births); however, maternal mortality levels still exceed those in other regions and can be further reduced through the increased use of SBAs. According to the most recent nationally-representative survey in Tanzania, less than half of recent births were attended by a skilled professional (48.9% in 2010) (NBS Tanzania and Macro, 2012).

Additionally, fertility patterns and sociocultural contexts related to Tanzanian women lead to elevated concerns about their maternal health. The population growth marks one of the highest levels, and women give the high number of births with the total fertility rate of 5.4

(NBS Tanzania and Macro, 2012). Due to the national marriage act permitting girls to marry at age 14 (with a parental consent) (Marriage act of Tanzania, 1971), early marriage remains a common practice. The negative consequences of such early marriage and childbearing have been major concerns (WHO, 2011). Women generally receive some formal education, participate in certain household decision-making, and live under perception of gender norms that are somewhat progressive (See descriptive results later).

The investigation of the influence of women's status and empowerment on SBA use in Tanzania is particularly important to examine recent shifts and countervailing influences on maternal health. In Tanzania and other Eastern African countries, the shifts of sociocultural norms and practice have been observed, some of which may be linked to uplifting women's status and power. In particular, patriarchal marital customs (e.g., arranged marriage, dowry, and polygamy) are undergoing changes (McCloskey et al., 2005; Lausen&Hollos, 2003). These sociocultural changes, as well as a decrease in family size (i.e., nuclear family structure), are viewed as progressive shifts for women's status and power in households (McCloskey et al., 2005; Lausen&Hollos, 2003). However, some gender norms as well as traditional customs (e.g., early marriage and sexual debut) appear to be unchanged, and women are continue to be at high risk of gender violence and sexually transmitted infections including HIV (NBS Tanzania&ICF Macro 2011; UNAIDS, 2014).

This study employed the 2010 Tanzania Demographic and Health Survey (DHS) dataset, a nationally representative household survey that collects data on a variety of population, health, and nutrition issues. The study sample consists of currently married women who had at least one birth during the five years preceding the survey. Questions on decision-making power were asked of married women only; thus, unmarried women were dropped from the analysis. Furthermore, a few women were dropped for missing data on the decision-making questions (n=11) and the perceptions of gender norms questions (n=82), yielding a final study sample of 4,445 (weighted) and 4,409 (unweighted). The proportion of missing observations is marginal – only 2.1 percent, thus the potential bias due to missing is negligible. The DHS survey developed the household weight and then individual weight that considers both household and individual levels. These weights adjust for differences in the probability of selection and interview among cases in the sample, as well as to account for the uneven probability of data collection among under-represented sub-groups.

**(2) Analytic Strategy and Measures**

This SEM analysis included five endogenous variables (that appear as dependent variables in at least one equation) and exogenous variables (that are never dependent variables). Endogenous variables were SBA use, household decision-making power,

perceptions of gender norms against violence, perceptions for sex negotiation, and age at first marriage. Exogenous variables were women's education and a series of control variables – sociodemographic characteristics of women and households and perceived difficulty in accessing health care.

The SEM for this study included two approaches for comparison: 1) a measured variable SEM (i.e., path analysis) and 2) a latent variable SEM. The measured variable SEM included the summative variables for decision-making power and the two perceptions of gender norms. The latent variable SEM included the measurement portion that was comprised of three factors and included individual indicators, as opposed to summative variables. The application of the two modeling approaches demonstrates a comparative utility of these factors relative to that of the summative variables.

### *Endogenous Variables*

***SBA use*** at childbirth was operationalized as the use of SBA(s) at the last childbirth in the five years preceding the survey. The variable was recoded as binary, in accordance with the WHO definition of SBAs (WHO, 2004). The SBAs included doctor or assistant medical officer, clinical officer, nurse or midwife; non-SBAs include MCH aide, village health worker, Traditional Birth Attendant, relative or friend, other, or no-one at the delivery.

***Age at first marriage*** was examined as a continuous variable that was calculated based on the date of the first marriage or union (phrased in the survey as "living with a man as if married") and the date of birth of the respondent.

***Household decision-making power*** was examined as a measured variable and then as a latent construct. The survey asked women about their participation in decisions regarding household matters, specifically their ability to decide on their own health care, major household purchases, and visits to family or relatives. The variables were first recoded to examine if the woman participated in the decision (i.e., either alone or jointly with their husband/family) or not. A measured continuous variable captured the number of decisions in which women participated (scored 0-3). Also, the three binary variables on each decision-making (i.e., either participated or not) reflected a latent construct.

***Perceptions of gender norms against violence*** also examined as measured variables and then latent constructs. The survey asked about women's acceptance of wife-beating by her husband/partner under five situations – if she goes out without telling him, neglects the children, argues with him, refuses to have sex with him, or burns the food. The variables were binary (i.e., yes or no). A continuous variable captured the number of situations in which women do NOT accept the violence (scored 0-5), with higher numbers indicating low acceptance of gender violence and, thus, more progressive. A latent construct was comprised of the five binary variables for each perception of gender norms against violence.

***Perceptions of gender norms for sex negotiation*** were assessed as another domain of perceptions. The survey also asked about women's perceived ability to negotiate sexual relations – if the respondent can refuse having sex or can ask her husband to use a condom. The variables were recoded to determine if the respondent can refuse/ask or not (i.e., cannot refuse/ask, don't know, not sure, or depends). A continuous variable captured the number of aspects with which women think that they can negotiate with their husband (scored 0-2). Each of the two indicators also reflected a latent construct.

### *Exogenous Variables – Women's Education and Control Variables*

***Women's education*** was examined as the years of education that the woman attended as a continuous variable. ***Sociodemographic characteristics of women and households*** were also included in the model as control variables. These include women's age at the delivery, parity, employment for payment, household wealth, marital and household relationship, the gender composition of children, and the place of residence. Women's age and parity (i.e., the birth order of the children) were examined as continuous, because a preliminary analysis using categorical variables showed a linear relationship with SBA use. Employment for payment was a binary measure defined as a woman who had been employed for cash or in-kind in the last 12 months, or not. Household wealth was examined using household asset

data, such as ownership of consumer items and home attributes. Principal component analysis was conducted by MEASURE DHS to develop a ranking of household wealth according to the scores, and households were then divided into quintiles. Marital relationship was assessed as categorical – monogamous union, polygamous as a first wife, or polygamous as a second wife or lower – to examine the potential differences by the type of relationship and wife order. Household relationship was assessed as binary – if the respondent was a household head or not. The gender composition of children, a binary variable, assessed if the respondent had at least one living son or not at the time of the delivery, considering the traditional value or preference for son that can reflect women's status and power (Fuse, 2008). The place of residence was a binary measure – if the respondent lived in an urban or rural area.

***Perceived difficulty in accessing health care*** was also included as a control variable, which assessed if the respondent perceived difficulty when seeking health care. The questions included: getting permission to go; getting money needed for advice/treatment; the distance to the healthy facility; or not wanting to go alone. The variables were first recoded into binary variables to show if the respondent perceived a big problem or not (i.e., not a big problem or not a problem at all). A continuous variable showed the number of items that the respondent perceived difficulties (scored 0-4).

**(3) Analytic Models and Steps**

Data analysis was conducted in the three main steps. First, descriptive analysis was conducted to show the distribution of the variables and calculate the means using SAS 9.3. Second, factor analyses were conducted using Mplus version 7.11. Exploratory Factor Analysis (EFA) identified the number of factors/latent constructs and the underlying factor structure of the set of indicators of empowerment. According to the EFA results, a three-factor Confirmatory Factor Analysis (CFA) was tested to examine the appropriateness and generalizability of the measurement portion of the SEM. Third, a SEM was used to examine the pathways from women's education to SBA use, through the proxy measures of empowerment. By testing multiple equations simultaneously and estimating standardized coefficients, a SEM also provided an examination of the multidimensionality of empowerment and the relative importance of one dimension over others. The analysis controlled for sociodemographic characteristics of women and households and perceived difficulty in accessing health care. All the analyses were conducted accounting for individual weights, clusters (i.e., Primary Sampling Unit), and sample strata using the survey analysis commands. These analyses were conducted with Mplus, which used polychoric correlations for categorical variables.

The SEM models analyzed five equations simultaneously for all five endogenous variables in my model. These equations separately regressed SBA use, household decision-

making power, perceptions of gender norms against violence, perceptions for sex negotiation, and age at first marriage using probit regression with the weighted least squares (WLSMV). Probit regression analysis is advantageous over logistic regression for more precise coefficient estimates, especially for mediation analysis (MacKinnon, 2008). This analysis employed listwise deletion[5] with missing observations, yielding an analytic sample of 4,357.

The models were built in steps. First, an unadjusted model was fit without control variables to examine the relationship between women's education status and SBA use and the mediating effects of age at first marriage, decision-making power, and perceptions of gender norms. Second, the adjusted model was fit that controlled for sociodemographic characteristics of women and households (in all the equations) and for perceived difficulty in accessing health care (in the equation regressing SBA use). In the models, all the exogenous variables were designated as covarying, because each of the exogenous variables was likely to be related one another. Also, the errors/disturbances of decision-making power and perceptions of gender norms were covarying, as the unobserved aspects of these constructs were also likely to be associated each other.

Model fit was assessed using the recommended combination of the model fit indices – Root Mean Square Error of Approximation (RMSEA) < 0.06 (or less as a "close" fit) and a

[5] This approach can be supported because of the negligible proportion of missing observations (2.1%) in the study sample (Bennett, 2011; Schafer, 1999).

Comparative Fit Index (CFI)/ Tucker-Lewis Index (TLI) with ≥ 0.95 (Hu&Bentler, 1999). Weighted Root Mean Square Residual (WRMR) (less than 0.90) was also calculated by Mplus for the models with categorical endogenous variables (Yu&Muthen, 2002).

## 5.5. Results

### (1) Descriptive Results

Table 5.1 provides the descriptive statistics for the study sample. Half of the respondents used SBA at the last birth (50.95%). With respect to the women's empowerment measures, on average women participated in 1.43 household-decisions (out of 3 household decisions), perceived that husband's violence is not justified in 3.16 situations (out of 5 situations), and perceived that they could negotiate their sexual relationships to some extent (Mean 1.38 out of 2). Women got married or started a union at mean age 18.28 years and started childbearing, on average, just under one year later (Mean 19.08 years) (data not shown). Women had attended an average of 5 years of formal schooling. They were on average 29 years old, and had approximately 4 children.

### (2) Factor Analysis Results

The underlying factor structure among the study indicators was suggested based on a geomin rotation, an oblique type of rotation that assumes the correlations among factors and

factor loadings of each indicator. EFA results suggest three factors based on the standard criterion of the number of eigenvalues of the correlation matrix >1.0 (Pett, 2003): 1) "***household decision-making power***" (to which three household decision-making measures loaded highly, over 0.80); 2) "***perceptions of gender norms accepting violence***" (five indicators about the acceptance/justification of gender violence, over 0.86); and 3) "***perceptions of gender norms for sex negotiation"*** (two indicators about the perceived ability to negotiate about sexual relationship, over 0.69) (See Table 5.2). The three factors are significantly yet not highly correlated, with factor correlations less than 0.25 ($p<0.05$), suggesting that each factor is distinct and can have different effects on SBA use. Age at first marriage had very low loadings (e.g., less than 0.2) on all the identified factors, suggesting that this does not comprise a factor and is a separate dimension from the others.

The three factor CFA results support the appropriateness and generalizability of the measurement portion of my SEM (See Table 5.2). The model fit statistics, especially RMSEA and CFI/TFI, show that the model fits the data well. Somewhat inconsistent is WRMR(=1.335), which is higher than the ideal cut-off; however, the CFA results generally confirm that the indicators reflected the factors well ($p<0.001$).

**(3) SEM Results**

The final adjusted SEM results for the structural portion of the latent variable SEM are presented in Table 5.3. Also, the final adjusted SEM results for the measured variable SEM are presented in Annex 5. Diagrams for the adjusted latent variable SEM, as well as the measured variable SEM are presented in Figures 5.2 and 5.3 (except control variables for the simplicity of the diagrams). The standardized path coefficients and the p-values in the unstandardized metric are reported.

The first analytic approach was the measured variable SEM that included the summative variables for household decision-making power (scored 0-3) and perceptions of gender norms against violence (scored 0-5) and for sex negotiation (scored 0-2) (Figure 5.2). The second approach was the latent variable SEM that included the three factors for decision-making power and perceptions of gender norms, respectively (Figure 5.3).

Model fit statistics show that the models fit the data well. For the measured variable SEM, RMSEA is 0.022, CFI is 0.997, TLI is 0.933, and WRMR is 0.377. For the latent variable SEM, RMSEA is 0.015, CFI is 0.992, TLI is 0.988, and WRMR is 0.917. These model fit statistics show that the both SEM models fit the data well. The measured variable SEM fits slightly better than the latent variable SEM, possibly due to the comparative difficulties in fitting the latent variable model that has the much higher number of degrees of freedom (DF=148) compared to that of the measured variable model (DF=4).

The results of the adjusted SEM models show that women's education and household decision-making power are positively related to SBA use (Column 5 in Table 5.3). This suggests that women with more education and higher decision-making power are more likely to use SBA. However, age at first marriage and perceptions of gender norms are not significant predictors for SBA use. Thus Hypothesis 1 is partially supported.

Additionally, women's age, urban residence, and high household wealth are positively related to SBA use. Parity, having living son(s), polygamous union, and perceived difficulties in accessing health care are negatively related to SBA use. Yet paid employment and household headship are not significantly associated with SBA use. The standardized path coefficient for education is almost identical with decision-making power, suggesting that the magnitude of effect of education on SBA use and the effect of decision-making power are almost the same. Several control variables demonstrate the greater magnitude of effects compared to education, most notably with lower parity, higher household wealth, and older age.

Age at first marriage is positively related to higher education, thus Hypothesis 2 is supported (Column 1 in Table 5.3). Yet age at first marriage is significantly associated with far fewer covariates – it is positively related to older age, while negatively related to parity, having son(s), and the first wife in a polygamous union.

Women's household decision-making power and progressive perceptions of gender norms are all associated with higher education, and share several of the same significant sociodemographic covariates. Women's decision-making power is positively related to higher education, older age, paid employment, heading household, having son(s), and lower parity, while negatively related to polygamous marital relationship (Column 2 in Table 5.3). Age at first marriage is not significantly associated with decision-making power. Thus Hypothesis 3 is partially supported. The magnitude of effect of education on decision-making power is higher than its effect on SBA use. In addition to education, several control variables demonstrate the high magnitude of effects, most outstandingly older age.

Perceptions of gender norms against violence are related to higher education, older age, paid employment, and lower parity, and the highest wealth quintile (Column 3 in Table 5.3). The magnitudes of effects of household wealth, age, and parity are higher than others. Also, progressive perceptions of gender norms for sex negotiation are positively related to higher education, paid employment, heading household, and the highest wealth quintile, while negatively related to polygamous marital relationship as second or lower wife order (Column 4 in Table 5.3). The magnitude of effect of higher education is much higher than that on accepting violence. Additionally, household wealth and polygamous relationship as second or lower showed much higher magnitude of effects than other predictors. Age at first

marriage is not significantly associated with either of the perceptions of gender norms constructs. Therefore, Hypothesis 4 is only partially supported.

The direct and indirect effects of women's education on SBA use from the latent variable SEM are presented in Table 5.4. In addition to the direct effect of women's education on SBA use, the total indirect effects of education on SBA use through all the identified pathways are significant ($p<0.05$). Yet the specific indirect effect estimate shows that only education's indirect effect through household decision-making power is significant. This suggests that women's higher education positively affects decision-making power, which in turn positively affects SBA use. This specific indirect effect of education (standardized b=0.009) contributes to the majority of its indirect effect. The proportion of the total indirect effect relative to the direct effect is substantial – 22.6% (the total indirect effect estimate of 0.019 over the direct effect of 0.084, as shown in Table 5.4). Thus Hypothesis 5 is partially supported.

The path coefficient results are almost identical between the measured variable SEM and the latent variable SEM (Figures 5.2 and 5.3). The R-square values for the latent constructs of empowerment proxies are slightly higher than those for the summative observed variables. Specifically, the R-square values for the observed variables are 0.058 (decision-making), 0.058 (perceptions against violence), 0.053 (perceptions for sex negotiation), while these values for the latent constructs are 0.085 (decision-making), 0.087 (perceptions against

violence) and 0.107 (perceptions for sex negotiation). Also, the R-square value is 0.388 for SBA use in the measured variable SEM, while it is 0.392 in the latent variable SEM. This means that the variance explained by the latent variable underlying the indicator is slightly better than the variance explained by the summative variable. This supports that the latent variable SEM explains the variance better than does the measured variable SEM. It should be also noted that the residuals for these three factors significantly correlate each other (<0.001), suggesting that the unexplained aspects of these variables are correlated.

## 5.6. Discussion

This study examined the pathways linking women's status and proxy measures of empowerment – age at first marriage, household decision-making power and perceptions of gender norms – to SBA use. The analysis provided evidence of the direct and indirect effects of education on SBA use through these empowerment measures, and demonstrated evidence of potential causal mechanisms affecting SBA use. The study also confirmed the multidimensionality of women's empowerment.

The study showed the significant and positive direct effect of women's education, as well as various sociodemographic characteristics of women and households, on age at first marriage, decision-making power, progressive perceptions of gender norms, and SBA use.

The findings of the effect of education support the study hypotheses, and are generally consistent with the previous evidence that women's education and other sociodemographic characteristics of women and households affect maternal health care seeking behavior and outcomes, as well as empowerment (Shiffman, 2000; Ahmed et al., 2010; Singh et al., 2011; Woldemicael, 2010; Woldemicael&Tenkoranga, 2010; Jarayaman et al., 2008; Babalola et al., 2009; Kitui et al., 2013; Ochako et al., 2011; Zere et al., 2011).

The study also confirmed that women's education is positively related to decision-making power, which in turn positively affects SBA use. This mechanism has been supported by the relevant theories and the integrated conceptual framework of this study (Blumberg, 1984; Collins et al., 1993). The analysis also revealed the variations of significance and magnitude of the indirect effects of education on SBA use through different pathways, and suggests the relative importance of specific mediation effects over others. Although there were no indirect effects of education on SBA use through certain pathways (i.e., age at first marriage, perceptions of gender norms), the significant association between women's education and SBA use is explained by women's empowerment, particularly household decision-making power. That is, lower education is associated with lower decision-making power, which then is negatively related to SBA use. Evidence of women's older age that positively relates to decision-making power and SBA use may imply that early marriage, which generally precedes early childbearing, may influence SBA use in a certain manner.

Yet the potential of age at first marriage and perceptions of gender norms in explaining the negative relationship between women's low education and non-SBA use is limited in this study setting, because neither age at first marriage nor perceptions of gender norms is a significant mediator. These findings partially support the relevant theories and the study hypotheses, such that only the direct and mediating effect of decision-making power on SBA use is significant, while those of age at first marriage and perceptions of gender norms are unclear.

This affirms the multidimensionality of empowerment and aligns with findings from critical review of the literature indicating the importance of considering the contextual nature of power and the importance of developing and testing measures that adequately capture this complex construct in different settings (Malhotra et al., 2002; Kishor&Subaiya, 2008; Upadhyay et al., 2014). In this setting where nuclear family is increasingly more prevalent, household decision-making power may be more indicative of power and thus more influential on reproductive health (McCloskey et al., 2005; Lausen&Hollos, 2003) as women may have greater say and opportunity to participate in household decisions. On the other hand, early marriage and perceptions of gender norms may not be indicative of women's power, possibly due to the fact that gender norms and marital customs are changing in Tanzania (McCloskey et al., 2005; Lausen&Hollos, 2003).

Furthermore, the study demonstrated the positive effect of older age at childbirth on SBA use, decision-making power, and perceptions of gender norms against violence. The importance of delaying the age at childbearing is underscored, in accordance with evidence that support for delaying marriage and childbearing to promote SBA use and positive delivery outcome (WHO, 2011; Magadi et al, 2007; Neal et al., 2007). Furthermore, older age at childbearing is linked to higher decision-making power and progressive perceptions of gender norms. This is consistent with the empirical evidence of early childbearing and perceptions of gender norms (Hindin, 2012) and the theory that describes the negative influence of women's participation in childbearing on their socioeconomic participation and power (Collins et al., 1993).

This study entails some limitations despite its addressing several research gaps. First, any causal inference is tentative, because the study employed a cross-sectional survey dataset. Despite the rigor of SEM, the direction of causation remains uncertain due to potential reciprocal effects (e.g., school girls might have dropped out due to marriage and/or pregnancy at early ages); however, relevant theories and descriptive results support the hypothesized causal relationships. The sensitivity analysis that designated the reversed pathway (i.e., age at first marriage influences education) also demonstrated the similar results and conclusions (data not shown). In accordance with the definition of empowerment as a *process* in acquiring power, its effect should ideally be examined over time using longitudinal data.

Second, the operationalization and measurement of women's status and empowerment was limited due to unavailability in the DHS dataset. The relevance of empowerment measures in DHS surveys has been generally supported in Asia, in which the measures were developed, but less so in Africa (Kishor&Sibaiya, 2008). Although existing decision-making questions only focus on household matters among married couples, women's decision-making power should have ideally captured "life strategic choices" (e.g., education, employment, desired marriage, childbearing, and fertility). All the available empowerment measures in DHS are limited to household matters, and the scope of decision-making and perceptions of gender norms should have been more comprehensive. These unobserved aspects possibly explain the correlations of disturbances (i.e., residuals) of the three factors representing women's empowerment, suggesting that there are omitted variable that should have been included in my analysis.

Third, the representativeness of the study sample and generalizability of the results are limited due to the omission of unmarried women and adolescents. Ideally, decision-making questions would be relevant and asked of all participants, regardless of marital status. The under-representation of adolescents is critical especially in light of growing evidence that adolescents, especially age 10-14, are at greater risk of delivery without skilled professionals, unsafe abortion, and maternal deaths (WHO, 2011; Bearinger et al., 2007; Magadi et al., 2007; Neal et al., 2012; Wellings et al., 2006; Pandey et al., 2011).

Lastly, in the latent variable SEM in particular, not all the indicators that reflect factors were normality distributed. In general SEM models are more easily fit when all the indicators are normally distributed. The indicators that reflect the three latent constructs were initially categorical variables and recoded as binary, because of their answer options in the survey. Yet the SEM model fits the date very well. For further improving the model fit, future research could use measures capturing the degree of perceptions or agreements (e.g., using likert scale with five rating scales).

Despite these weaknesses, this study is one of the first theory-based studies that examine complex pathways linking women's status and proxies of empowerment to SBA use, using a nationally representative sample of participants of reproductive age. This study added important evidence of potential causal mechanisms that women's empowerment mediates the relationship between women's status and SBA use in sub-Saharan Africa, by examining the direct and indirect pathways using SEM approaches involving multiple and sequential mediators.

This study addressed persistent methodological challenges and evidence gaps on the effect of women's empowerment measures on SBA use in SSA. This analysis built on previous research by examining the effects of four dimensions of empowerment – age at first marriage, household-decision-making power, perceptions of gender norms against gender violence, and perceptions for sex negotiation. The findings confirm the multi-dimensionality

of empowerment and the need to examine the individual dimensions of empowerment, as critical intervening factors in pathways leading to reproductive health service use and outcomes.

In summary, this study investigated the complex pathways linking women's status and empowerment to SBA use, and contributed evidence about potential causal mechanisms affecting SBA use, considering the multi-dimensionality of empowerment. Policy and program interventions that ensure women's access to higher education, that support delays in marriage and childbearing among girls, and that enhance decision-making power are likely to be effective in promoting SBA use and accelerating maternal mortality reduction.

**Table 5.1. Characteristics of participating, currently married women with at least one birth in last 5 years (n=4,445 weighted; n=4,409 unweighted), Tanzania Demographic and Health Survey (TDHS) 2010**

| Variables | Freq | Weighted | |
|---|---|---|---|
| | | Mean or Proportion | SE |
| **Outcome** | | | |
| Skilled Birth Attendant use at the last childbirth | 2,233 | 50.95 | 1.51 |
| **Mediators - Women's empowerment measures** | | | |
| Women's participation in household decision making (Mean, scored 0-3) | | 1.43 | 0.02 |
| Gender norms against violence (Mean, scored 0-5) | | 3.16 | 0.04 |
| Gender norms for sex negotiation (Mean, scored 0-2) | | 1.38 | 0.02 |
| Age at first marriage (Mean) | | 18.28 | 0.06 |
| **Demographics and perceived accessibility of health care** | | | |
| Education (Mean in years) | | 5.09 | 0.10 |
| Current age | | 29.38 | 0.15 |
| Household wealth quintile | | | |
| Poorest | 818 | 19.58 | 1.08 |
| Poorer | 957 | 22.61 | 0.96 |
| Middle | 905 | 21.47 | 0.92 |
| Richer | 954 | 19.99 | 1.12 |
| Richest | 775 | 16.35 | 1.14 |
| Employment for payment | | | |
| Currently employed or employed last 12 months | 1,717 | 38.07 | 1.10 |
| Parity (Total number of children ever born) | | 3.90 | 0.05 |
| Marital relationships | | | |
| Monogamous union | 3,394 | 78.87 | 0.53 |
| Polygamous as 1st wife | 434 | 8.97 | 0.53 |
| Polygamous as 2nd or lower | 549 | 12.16 | 0.82 |
| Household head | 251 | 5.67 | 0.47 |
| Place of residence | | | |
| Urban | 878 | 21.67 | 1.18 |
| Rural | 3,531 | 78.33 | 1.18 |
| Having son(s) | 3,628 | 81.38 | 0.67 |
| Perceived difficulty of health care (Mean, scored 0-5) | | 0.53 | 0.02 |

Note: Frequency missing= 32 (with marital relationships), 17 (with perceived difficulty in accessing health care).

**Table 5.2. Factor analysis for indicators of empowerment (n=4,445 weighted; n=4,409 unweighted), Tanzania Demographic and Health Survey (TDHS) 2010**

| *Latent construct* | *Indicator* | *Aspects that survey asked* | *Factor loadings (EFA)* | *t value (CFA)* |
|---|---|---|---|---|
| Household decision-making | health care | Decision on own health care | 0.795* | - |
| | purchase | Decision on major household purchases | 0.865* | 32.303* |
| | visits | Decision on visits to family or relatives | 0.939* | 32.267* |
| Gender norms accepting violence | go out | Violence if going out without telling her husband | 0.89* | - |
| | neglect | Violence if neglects the children | 0.922* | 87.206* |
| | argue | Violence if argues with him | 0.929* | 87.299* |
| | refuse sex | Violence if refuses to have sex with him | 0.883* | 79.863* |
| | burn food | Violence if burns the food | 0.863* | 56.115* |
| Gender norms for sex negotiation | negotiate sex | Perceived ability in refusing sex | 0.844* | - |
| | negotiate condom | Perceived ability in asking condom use | 0.693* | 8.006* |

Note: In the CFA, the path of the first indicator is constrained to 1 (thus t value was not calculated). Significance of t-values refers to unstandardized parameter values. *p<0.05. RMSEA=0.028 (CI=0.023-0.032); CFI=0.995; TLI= 0.993.

**Table 5.3. Standardized path coefficients of the latent variable SEM (n=4,357 for the analysis), Tanzania Demographic and Health Survey (TDHS) 2010**

| | **Dependent variables in the equation (Y):** | | | | |
|---|---|---|---|---|---|
| **Predictors in the equation (X):** | [Column 1] Age at first marriage | [Column 2] Household decision-making power | [Column 3] Perceptions of gender norms against violence | [Column 4] Perceptions of gender norms for sex negotiation | [Column 5] SBA use |
| Endogenous variables | | | | | |
| (1) age at first marriage | | 0.011 | -0.025 | 0.013 | 0.007 |
| (2) decision-making power | | | | | 0.083* |
| (3) gender norms against violence | | | | | -0.002 |
| (4) gender norms for negotiation | | | | | 0.042 |
| Exogenous variables | | | | | |
| Education | 0.158*** | 0.104*** | 0.061* | 0.220*** | 0.084*** |
| Age at childbirth | 0.918*** | 0.200*** | 0.134** | 0.004 | 0.183*** |
| Parity | -0.815*** | -0.118* | -0.129** | -0.035 | -0.216*** |
| Employment for payment | -0.015 | 0.066** | 0.083*** | 0.055* | 0.046 |
| Household head | 0.010 | 0.102*** | -0.015 | 0.073*** | 0.006 |
| Urban residence | -0.011 | -0.029 | -0.045 | 0.028 | 0.153*** |
| Having son(s) | -0.053** | 0.056* | 0.000 | 0.007 | -0.071** |
| Household wealth (the 2nd lowest) | 0.022 | -0.026 | 0.068** | 0.023 | 0.017 |
| Household wealth (the 3rd lowest) | 0.011 | -0.041 | 0.007 | 0.033 | 0.087*** |
| Household wealth (the 4th lowest) | -0.024 | -0.083* | 0.047 | 0.040 | 0.163*** |
| Household wealth (the highest) | 0.010 | 0.007 | 0.249*** | 0.091* | 0.304*** |
| Polygamous union as a first wife | -0.058*** | -0.064** | -0.023 | -0.026 | -0.063*** |
| Polygamous union as a second or lower | 0.010 | -0.132*** | -0.012 | -0.082** | -0.067*** |
| Perceived difficulty in accessing health care | | | | | -0.123*** |

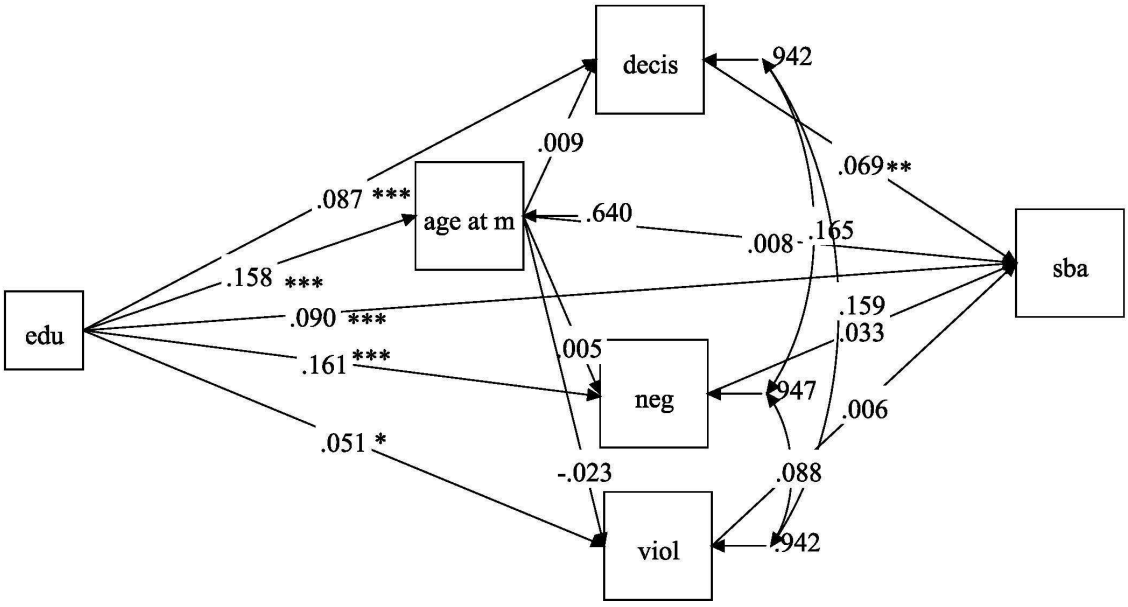
Note: ***p <0.001; **p<0.01; *p<0.05. Reference groups: residence=urban; household wealth= the lowest; marital relationship=monogamous union. DF=148, RMSEA=0.015, CFI=0.992, TLI=0.988, WRMR=0.917.

**Table 5.4: Summary of standardized direct and indirect effects of education on SBA use (n=4,357 for the analysis), Tanzania Demographic and Health Survey (TDHS) 2010**

| | | coefficient | t value |
|---|---|---|---|
| Total effect | | 0.103 | 4.716*** |
| Direct effect | | 0.084 | 3.654*** |
| Total indirect effect | | 0.019 | 2.236* |
| Indirect effect via | age at first marriage | 0.001 | 0.275 |
| | decision-making power | 0.009 | 2.406 * |
| | gender norms accepting violence | 0.000 | -0.056 |
| | gender norms for sex negotiation | 0.009 | 1.164 |
| | age at first marriage then decision-making power | 0.000 | 0.436 |
| | age at first marriage then gender norms accepting violence | 0.000 | 0.056 |
| | age at first marriage then gender norms for sex negotiation | 0.000 | 0.361 |

Note: ***p <0.001; **p<0.01; *p<0.05.

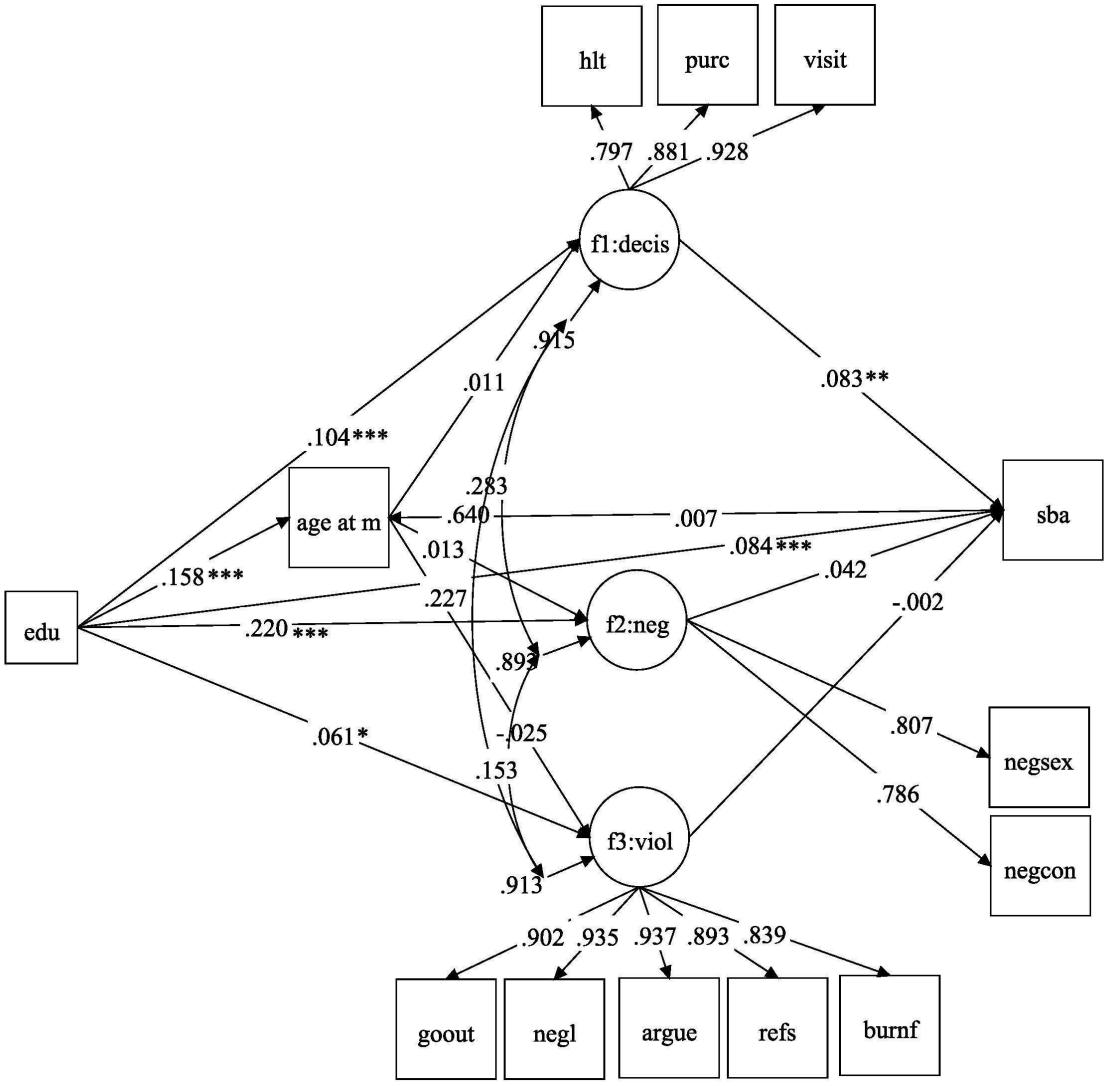
Figure 5.2. A diagram of the measured variable SEM




Note: ***p <0.001; **p<0.01; *p<0.05

sba=SBA use; decis=decision-making power; neg=gender norms for sex negotiation; viol=gender norms against violence; age at m=age at first marriage; edu=education.

Figure 5.3. A diagram of the latent variable SEM




Note: ***p <0.001; **p<0.01; *p<0.05.

sba=SBA use; f1:decis=decision-making power; f2:neg=gender norms for sex negotiation; f3:viol=gender norms against violence; age at m=age at first marriage; edu=education.

**Appendix 5. Standardized path coefficients of the measured variable SEM (n=4,357 for the analysis), Tanzania Demographic and Health Survey (TDHS) 2010**

| | **Dependent variables in the equation (Y):** | | | | |
|---|---|---|---|---|---|
| **Predictors in the equation (X) :** | [Column 1] Age at first marriage | [Column 2] Household decision-making power | [Column 3] Perceptions of gender norms against violence | [Column 4] Perceptions of gender norms for sex negotiation | [Column 5] SBA use |
| Endogenous variables | | | | | |
| (1) age at first marriage | | 0.009 | -0.023 | 0.005 | 0.008 |
| (2) decision-making power | | | | | 0.069** |
| (3) gender norms against violence | | | | | 0.006 |
| (4) gender norms for negotiation | | | | | 0.033 |
| Exogenous variables | | | | | |
| Education | 0.158*** | 0.087*** | 0.051* | 0.161*** | 0.090*** |
| Age | 0.918*** | 0.168*** | 0.112** | 0.004 | 0.183*** |
| Parity | -0.815*** | -0.098* | -0.110** | -0.027 | -0.219*** |
| Employment for payment | -0.015 | 0.050* | 0.071*** | 0.040* | 0.048 |
| Household head | 0.010 | 0.083*** | -0.014 | 0.051** | 0.011 |
| Urban residence | -0.010 | -0.025 | -0.037 | 0.017 | 0.155*** |
| Having son(s) | -0.053** | 0.046* | 0.001 | 0.007 | -0.069** |
| Household wealth (the 2nd lowest) | 0.022 | -0.022 | 0.062** | 0.019 | 0.016 |
| Household wealth (the 3rd lowest) | 0.011 | -0.031 | 0.007 | 0.026 | 0.086*** |
| Household wealth (the 4th lowest) | -0.024 | -0.068* | 0.039 | 0.031 | 0.161*** |
| Household wealth (the highest) | 0.010 | 0.005 | 0.200*** | 0.056 | 0.305*** |
| Polygamous union as a first wife | -0.058*** | -0.053** | -0.021 | -0.019 | -0.065*** |
| Polygamous union as a second or lower | 0.010 | -0.110*** | -0.011 | -0.061** | -0.072*** |
| Perceived difficulty in accessing health care | | | | | -0.123*** |

Note: ***p <0.001; **p<0.01; *p<0.05. Reference groups: residence=urban; household wealth= the lowest; marital relationship=monogamous union. DF=4, RMSEA=0.022, CFI=0.997, TLI=0.933, WRMR=0.377.

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# Chapter 6. Discussion

This dissertation investigated pathways linking women's status and power to SBA use in Senegal and Tanzania. In particular, this study assessed the focal relationship between women's education and SBA use, and also examined the intervening effects of proxy measures of women's power – age at first marriage, household decision-making power, and perceptions of gender norms against violence and for sex negotiation. The Theory of Gender Stratification informed the development of the conceptual framework, research questions, and analytic examination of potential causal pathways.

The dissertation comprises three aims and corresponding hypotheses, which were tested by varied statistical approaches, using multivariate regression analyses, mediation analyses, and structural equation modeling. The results highlighted the multidimensional and contextual nature of women's status and power, and also underscored the importance of examining the operationalization of women's power according to appropriate statistical approaches.

Overall, women's status and power were positively related to SBA use in both countries, yet there were substantial differences in the pathways and mechanisms by which these constructs are influencing each other.

## 6.1. Summary of Each Dissertation Paper

***Aim 1 paper (Chapter 3)***

The first paper of the dissertation (Aim 1) examined the association of women's education, age at first marriage, household decision-making power, and perceptions of gender norms against violence and for sex negotiation with SBA use in Senegal and Tanzania. Sequential regression analyses were conducted according to the elaboration model approach, using multivariate logistic regression and multiple linear regression analyses. This first paper demonstrated that the structure of women's power according to the dimensions available in the DHS data is the same across the two countries. However, the results indicated that there were different relationships of SBA use with women's status and power by dimension/aspect and by country. In particular, education and household decision-making power were positively related to SBA use in Tanzania. In contrast, age at first marriage, perceptions of gender norms against violence and for sex negotiation were positively related to SBA use in Senegal. The influences of some of the sociodemographic characteristics of women and households on SBA use also varied between the two settings in terms of direction and magnitude (e.g., employment, household wealth).

These varied influences demonstrated the importance of examining the likely disparate sociodemographic influences on women's status and power in each study setting, as

well as the unique pathways through which women's power may influence health service use and outcomes, including delivery care. Given that the construction of women's power composite measures also vary widely in the existing literature, a sensitivity analysis was also conducted as a part of Aim 1 to test the different operationalizations of women's power (e.g., summative continuous/binary, each indicator). These variations in operationalization, however, yielded nearly the same conclusions.

***Aim 2 paper (Chapter 4)***

The second paper of the dissertation (Aim 2) assessed the mediation effects of age at first marriage, household decision-making power, and perceptions of gender norms against violence and for sex negotiation on the relationship between women's education and SBA use in Senegal and Tanzania. After the regression analyses, mediation analyses were conducted – the product of coefficients tests and Sobel tests – to assess the statistical significance of the mediation effects.

Among the measures of women's power, the significant predictors for SBA use in the Aim 1 results were found to be significant mediators, thus the mediators differed by country (e.g., decision-making in Tanzania, perceptions of gender norms in Senegal). In particular, household decision-making power was found to mediate the relationship between education and SBA use in Tanzania, yet in Senegal, progressive perceptions of gender norms against

violence and for sex negotiation both mediated the relationship between education and SBA use. Moreover, although the direct effect of education on SBA use was significant only in Tanzania, its indirect effects were significant in both settings. This suggests that women's formal education by schooling can positively and directly influence SBA use in Tanzania; additionally, schooling positively influences decision-making power, which in turn promote SBA use. Conversely, in Senegal such schooling may not directly increase SBA use. However, schooling positively influences progressive perceptions of gender norms, possibly due to exposure to such norms, which in turn promote SBA use.

This paper demonstrated the importance of education as a determinant of SBA use and confirmed the varied pathways in which education influences SBA use. These findings also highlighted the importance of formal mediation tests in addition to regression analysis, to facilitate a more holistic identification and understanding of the mechanisms by which women's status and power may influence health behaviors and outcomes, as well as how these mechanisms specifically operate to alter behavior and outcomes (MacKinnon, 2008).

***Aim 3 paper (Chapter 5)***

Lastly, the third paper of the dissertation (Aim 3) tested the complex pathways between women's education and SBA use in Tanzania using Structural Equation Modeling. The models were specified according to a sequential pathway – through age at first marriage

first, and then household decision-making power and perceptions of gender norms against violence and for sex negotiation. Two SEM models were estimated – the measured variable SEM that included the summative variables for decision-making and the two domains of perceptions of gender norms, and the latent variable SEM that included the measurement portion that was comprised of three factors and included individual indicators.

In accordance with the Aim 2 results, this analysis provided evidence of the direct effect of education on SBA use, as well as its indirect effect through household decision-making power, but not through other proxies of power. By testing multiple equations simultaneously and standardizing path coefficients, the results demonstrated the relative importance of specific direct and indirect effects on SBA use over others. Specifically, household wealth, parity, age at delivery, and urban residence demonstrated greater influences on SBA use relative to other variables.

Additionally, the comparison of the two SEM approaches – the measured variable SEM and the latent variable SEM – highlighted the relative benefit of representing women's power as a latent construct as compared to measured variables. This confirmed that women's power and empowerment are latent constructs that comprise various dimensions and indicators, and that future research efforts should consider this in the operationalization and measurement of power and empowerment. Overall, this paper built on previous literature by demonstrating the utility of SEM as a rigorous analytic approach that can empirically identify

and test the complex constructs inherent in and pathways by which women's status and power affect SBA use.

## 6.2. Comparison of Findings and Conclusions Across Aims

The results from each of the three papers of the dissertation analysis generally align. Across all three papers, the analyses indicated that education was positively and indirectly related to SBA use in both settings; however, women's education was positively and directly associated with SBA use in Tanzania, but not in Senegal. Even when examining alternate modeling strategies for the measures of women's power (e.g., summative binary, each indicator), the analyses generally indicated the same or very similar conclusions. Among the tested proxy measures of women's power, significant mediators based on the mediation analysis under Aim 2 were significant predictors of SBA use under Aim1 – household decision-making power in Tanzania, while perceptions of gender norms against violence and for sex negotiation in Senegal.

These consistencies of the conclusions supported the appropriateness of each of the employed analytical methods for the respective aims. For example, the logistic regression results from Aim 1 provided the same conclusion with those from the SEM for Aim 3 that used probit regression, with one exception (i.e., employment) showing a borderline significance in the SEM. It should be noted however that the magnitude of the coefficients

was not directly and substantively comparable across the models due to the limitations of logistic regression (See Limitation section later, Page 263).

Furthermore, the conclusions of the mediation results from Aim 2 were almost identical with those from the SEM under Aim 3 – household decision-making power significantly mediated the relationship between education and SBA use in Tanzania. This is consistent with the evidence and support by MacKinnon et al (2002), suggesting the relevance of Sobel tests for categorical outcome models, especially when the sample size is large enough, despite the fact that Sobel tests assume a continuous outcome variable. These consistencies of conclusions also support the relevance of women-based analysis that was applied for the SEM (Aim 3), especially in Tanzania, as well as birth-based analysis for the majority of my dissertation analysis (Aim 1 and 2).

## 6.3. Strengths and Limitations of Dissertation Analysis

### 6.3.1. Strengths

This study entails five key strengths for research and policy interventions. First, this study is one of the first theory-based studies that examine complex pathways linking women's status and power to SBA use, using nationally representative samples. This study added important evidence of potential causal mechanisms by which women's status and

multiple dimensions of power are related to SBA use in sub-Saharan African countries – Senegal and Tanzania – using varied analytical approaches. In previous examinations of delivery care use in Africa, only one known paper explored the mediation of women's power (Fotso, 2009). Yet none of the existing studies from Africa formally tested the mediating effect of women's power using mediation tests or SEM.

Second, this study provided more comprehensive insights and critiques on the current empowerment paradigm in public health research. For example, this study employed the theory-based conceptual framework, and used the terms women's power and empowerment aligning with their distinctions according to theory and conceptual definitions (Blumberg, 1984; Safilios-Rothchild, 1982; Kabeer, 2001). This paper intended to bridge this gap between gender theory and typical operationalization in the literature, particularly due to the way the DHS operationalized and measured empowerment. Distinctions in conceptualizing these terms should be clear in enhancing and organizing the understanding of power and empowerment separately.

Third, the analysis also highlighted the important methodological considerations, especially in operationalizing women's power, and empowerment as a process. Despite prevailing concerns regarding the concept, operationalization, and measurement of power and empowerment, there is little advancement to date. In this analysis, the operationalization of women's power was determined by factor analysis (i.e., EFA and CFA). The multiple

dimensions of women's power were identified, which relate to SBA use differently by dimension and country. The importance of the influence of women's life strategic events was supported: age at the delivery was positively and significantly related to SBA use, as well as several proxies of power; age at first marriage was positively related to women's education and was somewhat influential to other dimensions of power and/or SBA use. The appropriateness of analysis considering these multiple dimensions was supported by the model statistics from the regression analysis, factor analysis, and SEM. Thus the relevance of one single index of power as a sum of various indicators may be questioned.

Fourth, this study demonstrated that these complex mechanisms differ by country and that there is heterogeneity across African countries, cautioning against generalizing from some setting to another. In particular, the influence of women's education and power on SBA use differed greatly by country. Additionally, the influence of sociodemographic characteristics of women and households were disparate across settings. For example, employment was related to SBA use in opposite directions in the two countries and was related to measures of power differently by country. These disparate influences of employment as a measure of women's power and as an indicator related to SBA use have been debated by other scholars in this area (Kabeer, 1997), and once again highlighted the contextual nature of women's status and power in terms of implications and determinants. In exploring the contextual influences on women's power and SBA use, conditional effects of

sociodemographic characteristics (e.g., wealth, residence) could be examined in future research. Indeed, the moderation results showed that the magnitude of effect of women's power on SBA use differed by education, suggesting that other sociodemographic variables related to women's status may also have such conditional effects.

Fifth, these study findings lead to policy and programmatic recommendations to promote SBA use as a means of reducing maternal deaths. Women's education has a potential in promoting SBA use, directly and indirectly – by directly elevating the likelihood of using SBA, and through uplifting women's power. Health policy and programs designed to promote SBA use and to reduce maternal deaths should be integrated and/or complimented by programs addressing women's status, women's power in households, and gender equity in society. Although this dissertation analysis focused at the individual level, gender norms and interactions are deeply entrenched within cultures and societies, thus there is also need to identify and address the ways in which communities and societies at large can better facilitate gender equity. Such efforts also need to consider the implications and influences of male involvement, as husband's characteristics (e.g., education) and possibly the relationship between couples can influence women's power and delivery care use. Programs targeting men have a potential to change gender-role norms, prevent gender-based violence, and facilitate women's empowerment in low-and middle-income countries (Heise, 2011).

In addition to programs such as these, further advocacy and policy efforts are needed to support girls and women in achieving better health outcomes. For example, the effectiveness of the programs that focus on changing social norms among parents and community members regarding early marriage has been promising (Lee-Rife, et al. 2012). An enabling legal and policy framework is also likely to make changes in society at large, thus the national policy and law should prohibit early marriage and childbearing according to the corresponding international law and global guidelines.

### 6.3.2. Limitations

***Limitations of the dataset***

This study entails some limitations regarding the dataset and analysis, despite its addressing several research gaps. There are four key limitations related to the dataset. In summary, the first limitation is that this study used cross-sectional survey datasets at one point in time, thus any causal inference is tentative due to potential reciprocal effects. In order to examine the effect of empowerment as a process according to its definition, it should be examined over time ideally using longitudinal data, or repeated cross-sectional designs.

Second, ideally, the survey would have collected more comprehensive information on women's power to improve operationalization and measurement. Inherently it is challenging to compare women's power across settings, due to its culturally- and contextually-defined

characteristics, and the limitation of existing DHS measures are clearly highlighted in this cross-national study. The use of matched couple data was considered, which includes additional information on relations between married couples, but was disregarded due to its far smaller sample size. The findings from the SEM models, particularly the correlations of disturbances (i.e., errors) between women's power dimensions, also show that there are unobserved variables that are common across these dimensions of power.

For example, regarding decision-making, women's ability in deciding and achieving "life strategic choices" should have been measured (e.g., education, employment, marriage, childbearing), but not limited to choices/decisions on household matters between couples. Similarly, perceptions of gender norms should not be limited to domestic violence and negotiations about sexual relations among couples, but should have captured broader perceptions related to such life strategic choices and gender-role norms. Additional domains of power, which have a potential to positively influence women's reproductive health, could have been also assessed according to theory and Kabeer's definition (2001), including women's participation in social networks (e.g., women's group) and politics (e.g., community leadership) that represent "resources" and/or "achievements".

Third, the survey could have captured additional information on potential determinants of delivery care use. As suggested by literature and conceptual framework (e.g., the Three Delays Model), a series of supply-side factors are important determinants of

delivery care use, including the actual and perceived availability and quality of care (Thaddeus&Maine, 1994; Koblinsky et al., 2006). This analysis controlled for the perceived difficulty in accessing health care. Yet additionally, the actual accessibility of health care, the availability of care/facilities, and the actual and perceived quality of care could have been assessed, because they would be important considerations in increasing SBA use and determining how these aspects are related to women's status and power.

Although the premise of this dissertation is that more empowered women will choose to use an SBA, it is also possible that more empowered women may choose to deliver at home and without skilled assistance (e.g., Traditional Birth Attendants). Women's intention to seek delivery care use could have been ideally assessed to understand women's preference and actual ability to achieve their intention regarding delivery, which informs more acceptable models of delivery care for women, families, and communities. In some countries (e.g., Bangladesh) SBAs assist with home deliveries. The effectiveness and cost-effectiveness of such community-based services have been supported in reducing maternal deaths as well as costs (e.g., c-section) by providing care before complications (UNFPA, 2014; Ahmed&Jakaria, 2009). Although it is imperative to ensure linkages and referrals to health facilities (UNFPA, 2014), this alternative model may better align with women's preferences and overcome persistent barriers in accessing delivery care at the facility (e.g., transport, sociocultural norms).

Fourth, the representativeness of this study sample and the generalizability to all women in these countries is not clear due to the under-representation of adolescents and currently unmarried women in this analysis. This limitation further highlights the importance of the more comprehensive measures of power that are relevant regardless of marital status. Due to the exclusion of currently unmarried women from this study, the estimates from my analysis are likely to be biased in different manners. Examples include the lower estimates of the influence of power on SBA use in Senegal, because the characteristics of excluded women suggest that they are likely to have higher power relative to currently married women. Also in Tanzania, this effect may be underestimated, because unmarried women are more likely to head households and have elevated power. Given that the majority of unmarried Tanzanian women are ever married (e.g., divorced, widowed) and may be isolated and disempowered, the effect of power may also be overestimated.

For better representativeness and generalizability, the present DHS strategy to sample women over age 15 should be also reconsidered in response to the growing evidence and programmatic attention that adolescents, especially age 10-14, are at greater risk of delivery without skilled professionals, unsafe abortion, and maternal deaths (WHO, 2011; Bearinger et al., 2007; Magadi et al., 2007; Neal et al., 2012; Wellings et al., 2006; Pandey et al., 2011). The exclusion of this population may also bias my estimates, as young women are likely to have lower levels of power (UNICEF, 2011).

***Limitations of the analysis***

Furthermore, there is another set of weaknesses regarding the analytic approaches. First, in the regression analyses used for Aim 1 and 2, logistic regression was mostly conducted, because my focal dependent variable was a binary measure (i.e., SBA use or not). Logistic regression entails several different features, relative to linear regression, as well as limitations (Aneshensel, 2013; Mood, 2010). Due to the issue of unobserved heterogeneity – that is the variation in the dependent variable due to omitted variables (Mood, 2010) (See Method chapter for details, Page 80), it was not possible to directly and substantively compare the magnitude of the effects of independent variables across models, groups, and samples. It is possible to solve this problem by replacing the latent continuous variable (i.e., unobserved continuous variable) with an observed continuous variable (Mood, 2010). Yet it was not feasible with my analysis, because latent continuous variables were measured through multiple indicators (e.g., household decision-making variable measured by three separate indicators) and could not be replaced by an observed continuous variable (e.g., one single variable/indicator that measures decision-making as continuous).

Other potential solutions can also partly handle the problem. For example, comparison of models in the same sample could be possible by standardizing the coefficients of the latent continuous variables (i.e., y-standardization). However, this is not applicable for comparing different samples (e.g., across countries). The potential bias in mediation analysis

due to the y-standardization is also cautioned (MacKinnon, 2008). Other approaches for group comparison include the generalized linear model that compares logit and probit coefficients across groups; average partial effects method that averages marginal effects (i.e., the effect of exploratory variables conditional on the specified characteristics) of all independent variables (Mood, 2010). Yet these approaches are not applicable to binary and other categorical variables. Each of these solutions and alternatives entails strengths and limitations, and their application and relevance are still studied for methodological advancement (Aneshensel, 2013; Mood, 2010).

Second, related to the issue of logistic regression, comparisons across these study settings were also limited due to survey weights. The comparison of the two settings could have been more rigorous if their significant differences could have been statistically tested. The combination of the two datasets was considered, yet it was not possible due to the complexity of reconstructing survey weights for the two settings. However, this preliminary comparative analysis using the two datasets demonstrated clear contrasts, suggesting that there were differences in determinants and their mechanisms affecting SBA use in these countries.

Third, specifically in regression analysis under Aim 1, the relationship of SBA use with potential predictors was examined. The estimation of the direct influence of predictors did not help in formally identifying indirect effects. Indeed the regression analysis in Senegal

found that education was not related to SBA use. Yet education was indirectly related to SBA use through women's power as shown under Aim 2 using mediation tests. This finding indicated that the regression analysis could mask the influence of certain predictors when mediators were included in the model. That is, the regression approach is limited in its ability to examining relationships that involve intervening variable(s). The effect of predictors should be assessed not only in terms of direct effects but also indirect effects separately, using a formal mediation analysis.

Fourth, under Aim 2, mediation analysis examined the indirect effect of education on SBA use through women's power, using regression coefficients derived from separate models. The precision of the coefficients may be inferior, relative to those from the SEM (Aim 3) that tested multiple equations simultaneously. However, the comparison of conclusions from the two approaches suggests that this concern is minimal. This is consistent with the supportive evidence for Sobel tests with categorical outcomes when sample size is large enough (MacKinnon et al., 2002). The generalizability and precision of mediation results could have been improved through bootstrapping, however, this is not possible for complex survey data with currently available software packages.

Lastly, SEM under Aim 3 is a more rigorous analytic approach in testing theory and causal mechanisms, yet causal inference is still tentative due to the cross-sectional survey dataset. Reverse causality was considered and tested, as early marriage can lead to lower

education level (e.g., dropout). Although the respecified model that considered this reversed pathway fit the data as well as my final model, the descriptive statistics did not support this time sequence based on the mean years of education and age at first marriage. Another respecified model that considers the bi-directionality between education and age at first marriage was not identified, thus coefficients were not estimated accordingly. Therefore, the final SEM models under Aim 3 are more relevant in accordance with my theory-based conceptual framework and the descriptive results. Also, in my model, one latent construct (i.e., perceptions of gender norms for sex negotiation) was comprised of only two indicators, which could negatively affect efficiency in estimation (i.e., smaller standard errors). Yet the close model fit of my latent variable SEM suggested that this concern was negligible.

## 6.4. Conclusion

In summary, this study provided evidence of potential causal mechanisms and complex pathways linking women's status and power to SBA use, confirming the multidimensional and contextual nature of women's power in two distinct African countries – Senegal and Tanzania. This evidence demonstrated the disparate influences of women's education, directly and indirectly, as relate to SBA use. The diverse pathways and mechanisms by which women's status and power influence SBA use highlighted the need for in-depth country analysis including mediation analysis, in single- and multiple-setting

studies. This evidence also shed light on the importance of culturally and contextually tailored policy and program interventions to uplift women's status and power, in an effort to promote SBA use and to accelerate maternal mortality reduction. Further examination is necessary, however, for the better understanding of these mechanisms over time, especially in contexts undergoing rapid sociodemographic changes, such as is the case for these two countries. Moreover, these mechanisms are likely to differ across reproductive health behaviors and outcomes and for different subgroups in these populations. Thus, further investigations of these influences are critical to understanding and better addressing persistent disparities in women's health as a result of pregnancy and childbirth, and particularly for women living in low- and middle-income countries.

**Chapter Six References**


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