Investigating pathways linking women’s status and empowerment to skilled attendance at birth in Tanzania: A structural equation modeling approach

Kyoko Shimamoto*, Jessica D. Gipson

Fielding School of Public Health, University of California, Los Angeles (UCLA), California, United States of America

* kyoko0517@ucla.edu

Abstract

Maternal and newborn mortality remain unacceptably high in sub-Saharan Africa where use of a skilled birth attendant (SBA) at delivery has remained low. Despite the recognized importance of women’s empowerment as a key determinant of maternal and newborn health, evidence from sub-Saharan Africa is more limited. Using data from the 2010 Tanzania Demographic and Health Survey (n = 4,340), this study employs a robust method—structural equation modeling (SEM)—to investigate the complex and multidimensional pathways through which women’s empowerment affects SBA use. The results show that women’s education and household decision-making are positively associated with SBA use. However, not all empowerment dimensions have similar effects. Attitudes towards sex negotiation and violence as well as early marriage are not significant factors in Tanzania. Mediation analysis also confirms the indirect effect of education on SBA use only through household decision-making. The findings underscore the utility of structural equation modeling when examining complex and multidimensional constructs, such as empowerment, and demonstrate potential causal inference to better inform policy and programmatic recommendations.

Introduction

Maternal and newborn mortality remain unacceptably high in low- and middle-income countries, where 99.7% of global maternal deaths and 98.5% of newborn deaths occur. Over three hundred thousand women died from causes related to pregnancy and childbirth globally in 2015, and 2.6 million newborns died in 2016, although most of those deaths were preventable [1, 2]. Sub-Saharan Africa has some of the highest rates of maternal and newborn mortality with an average maternal mortality ratio (MMR) of 510 per 100,000 live births and a neonatal mortality rate (NMR) of 28 per 1,000 live births.

The evidence indicates that maternal and newborn deaths could be averted substantially by the professional care provided at childbirth by a skilled birth attendant (SBA) [3]. However, the levels of SBA use remain low, particularly in Africa where only half of deliveries have an...
SBA present and progress is much slower compared to other regions [4, 5]. The WHO defined an SBA as “an accredited health professional who is proficient in the skills needed to manage normal (uncomplicated) pregnancies and childbirth, and to identify, manage and refer complications in women and newborns” [3]. Investments in healthcare around the time of birth have been identified as the most effective approach to reduce maternal and newborn mortality with an estimated 150,000 maternal lives and 790,000 neonatal lives that could be saved, as well as 550,000 stillbirths that could be prevented by 2025 [3, 6, 7].

Several African countries and other low-income countries struggle to achieve further reductions in maternal and newborn mortality due to a complex set of constraints affecting access to and use of relevant services. Key common barriers include socioeconomic factors (e.g., low education and economic status), geographic factors (e.g., physical distance and transportation means), limited human resources and supplies, and poor quality of care [6, 8–10]. Furthermore, recent evidence and global policy discourse indicate that gender equality and the power women wield in their households, communities and societies are more critical determinants for the health of women and their newborns [6, 10–13]. Although studies from Africa are limited compared to those from Asia, existing studies point to the important influence of women’s status and empowerment, and there is a need for further studies that critically examine the complex and contextual connections between women’s empowerment and maternal health, including delivery care use [8, 12, 14] [15–20].

This study aims to address these needs by employing structural equation modeling (SEM), which is an approach that is useful for investigating potentially complex and multidimensional pathways. We employ SEM to examine the complex pathways between women’s empowerment and SBA use in Tanzania, a setting where more than a third of deliveries are not attended by an SBA.

Background

Women’s status, empowerment, and delivery care use

Women’s status and empowerment have been recognized as important influences on a range of health and social behaviors as well as outcomes, including contraceptive use, fertility, delivery care, and, more broadly, poverty reduction and economic growth [11, 13, 21–23]. “Women’s empowerment” is an inherently complex and contextually defined construct, though it is broadly defined as the ways in which women’s social position may affect their abilities to make decisions and to take actions related to their health and well-being [11, 21, 24]. Kabeer defined empowerment as “women’s ability to make strategic life choices”, which comprises three, interrelated dimensions, including “resources, agency, and achievements” [21].

Much of the existing literature assesses “agency” and “resources” through proxy measures, such as women’s participation in household decision-making, access to and control over household resources, and attitudes towards gender norms (e.g., violence, gender equality and relationship) [11, 21, 22]. “Achievements” are the outcomes of empowerment and conceptualized as the ability to make “strategic life choices”, including marriage and childbearing [21]. This domain is increasingly recognized as an important marker of women’s status and empowerment in that the timing and circumstances surrounding these events reflect the extent to which women have a choice in these decisions [25–28]. “Women’s status”, on the other hand, is generally considered to be a measure of “women’s overall position in the society” [24], which is often represented by a woman’s educational attainment as well as her economic or employment status.

Most of the evidence linking women’s status and empowerment with maternal health care use is from South Asia; however, an increasing number of studies are emerging from Africa.
One set of African studies examines the influence of education on delivery care use and found generally consistent and positive relationships [14–20, 29–34]. Furthermore, studies that focus more explicitly on the relationships between women’s empowerment and delivery care use in Africa are even more limited and the evidence is mixed [14–20, 29]. Some of these studies examined multiple dimensions of empowerment, finding inconsistent effects of empowerment dimensions on delivery care use [15–18, 20]. For example, a study in eight African countries, including East African countries (e.g., Uganda, Zambia), showed disparate influences of women’s empowerment domains (i.e., decision-making, attitudes towards gender norms) on delivery care [15]. A subsequent study using multi-level modeling that controlled for non-independence within the country found no significant effect of household decision-making on delivery care use [17]. Moreover, despite growing concerns regarding the connections between early marriage, childbearing and women’s empowerment [35–37], studies are very limited in Africa compared to Asia. Only one cross-national study was identified that examined this issue in Sub-Saharan Africa, demonstrating that early childbearing adversely influences women’s future empowerment [25].

**Methodological approaches**

The disparate relationships between women’s empowerment and maternal health may be explained, at least in part, by two key methodological issues. First, there is no standard operationalization or measurement of empowerment, which makes the study of empowerment inconsistent across studies and settings [11, 22]. The importance of considering the multiple dimensions of empowerment [21] has been increasingly stated, yet summative measures or composite indices are often employed, which results in an inability to deconstruct the distinct influence of each empowerment dimension. Several studies have incorporated multiple empowerment dimensions [15–20, 28]; however only a handful of studies have employed analyses (e.g., factor analyses) to specifically examine the underlying structures and relationships between empowerment domains when examining maternal and reproductive health outcomes [20, 29, 36, 38–41].

Second, the existing global studies on delivery care have rarely employed SEM, despite its usefulness in identifying the complex connections between distinct empowerment domains and health outcomes. The current manuscript builds on work conducted by the authors in two, separate analyses [20, 41]. In the first analysis, authors assessed SBA use in Senegal and Tanzania using simple multivariate analyses. A subsequent analysis employed SEM to examine the complex mechanisms through which the multiple empowerment domains affect SBA use specifically in Senegal [41], and to provide greater potential into causality of these pathways [42, 43].

**Conceptual framework**

This analysis employed an integrated conceptual framework from the Theory of Gender Stratification [44, 45] to identify the social determinants to women’s reluctance or inability to seek reproductive health services, which results in negative health outcomes such as maternal mortality (Fig 1). Fig 1 shows that women’s status, which was operationalized as women’s education, promotes empowerment, which in turn increases SBA use. Specifically, the theory and framework would suggest that the greater women’s power is, the more they have “control over their lives” and various “life options” (e.g., marriage, divorce, and sexuality) [44].

The relationship between education and SBA use is hypothesized to be mediated by multiple dimensions of empowerment. Specifically, a woman with more education is likely to marry later, to have higher household decision-making power and to have more progressive attitudes
towards gender norms. Consequently, women with more education are more likely to use an SBA. These empowerment dimensions are frequently chosen and examined in studies using the Demographic and Health Survey (DHS) data [27]. Furthermore, this framework considers the potential confounding effects of sociodemographic characteristics of women and households as well as the perceived difficulty in accessing health care [10].

Methods

Study setting and data

Maternal and neonatal mortality has declined in Tanzania over the last two decades (MMR from 910 to 410; NMR from 41 to 22); however, the country ranks in the top ten countries in the world in terms of the number of annual maternal deaths (8,200) [1, 2]. Maternal and newborn mortality reductions are likely contingent on increasing SBA use during childbirth. According to the most recent surveys, 64% of deliveries were attended by SBAs in 2015, which was an increase from 51% in 2010 [46, 47].

Examining the connections between women’s empowerment and SBA use is particularly important in Tanzania given the recent shifts in gender relations and their countervailing influences on maternal health. Studies from Tanzania and other eastern African countries suggest that women’s status and power in households is increasing alongside notable declines in patriarchal marital customs (e.g., arranged marriage) [48, 49]. Other norms and traditional customs (e.g., early marriage, sexual debut), however, appear to be unchanged [46].
This study used data from the 2010 Tanzania DHS, which is a nationally representative household survey [46]. The study sample consisted of currently married women who had at least one birth during the five years preceding the survey. Questions on household decision-making were asked of married women only; therefore, unmarried women were removed from the analysis. Furthermore, women with missing data concerning decision-making, gender norms, and sociodemographic variables were removed, which resulted in a final analytic sample of 4,340 women (weighted). The proportion of missing observations is marginal (only 3.7 percent), and thus, potential bias due to missing data is negligible. All analyses included household and individual weights to adjust for differences in the probability of selection and interviews among the individuals included in the sample. In the DHS surveys, trained interviewers provided a standard introduction at the beginning of the interview to explain the study and to seek consent for participation. The interview was undertaken with participants who provided verbal consent. This was a secondary data analysis of the global survey for which ethical approvals were already obtained by an ICF Institutional Review Board (IRB) and an IRB in the host country. Thus, a separate ethical approval for this specific study was not required by the UCLA IRB.

Analytic strategy and measures

Latent variable SEM was employed for this study, which included both a structural portion (i.e., with measured variables) and a measurement portion (i.e., with latent constructs). The latent variable SEM was comprised of three latent constructs, each of which included individual empowerment indicators to represent each dimension. The latent variable SEM included five endogenous variables (i.e., variables that appear as dependent variables in at least one equation) and multiple exogenous variables (i.e., variables that are never dependent variables). The endogenous variables were SBA use, household decision-making, gender-role attitudes and age at first marriage. The exogenous variables were women’s education, sociodemographic characteristics of women and households and perceived difficulty in accessing health care.

**Endogenous variables.** *SBA use* at childbirth was operationalized as the use of SBA(s) for the last childbirth. The variable was recoded as binary per the WHO definition [3]. SBAs included a doctor or an assistant medical officer, a clinical officer, a nurse or a midwife. Non-SBAs included an MCH aide, a village health worker, a traditional birth attendant, a relative or friend, another individual, or an unattended delivery.

*Age at first marriage* was examined as a continuous variable that was calculated by MEASURE DHS, and it was based on the date of the first marriage or union (“living with a man as if married”) and a respondent’s date of birth.

*Household decision-making power* was examined as a latent construct consisting of three indicators: women’s participation in decisions regarding their own health care, major household purchases, and visits to family/relatives. The variables were first recoded to examine if women participated in decisions (i.e., alone or jointly with their husband) or not. A latent variable was constructed from the three binary variables for each decision.

*Attitudes towards violence* was examined as a latent construct consisting of five indicators: women’s acceptance of wife-beating by her husband/partner under five situations, including 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 also recoded as binary (i.e., yes or no).

*Attitudes towards sex negotiation* were also assessed as a latent construct based on two questions regarding women’s perceived ability to negotiate sexual relations, including if the respondent can refuse to have 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 or ask, do not know, not sure, or depends).
Exogenous variables—Women’s education and control variables. Women’s education was measured as a continuous variable representing the number of years that the woman attended school. Sociodemographic characteristics of women and households were included in the model as control variables. The characteristics included a woman’s age, parity, paid employment, household wealth, marital and household relationship, gender of children, place of residence, and a woman’s age and education relative to her husband. A woman’s age at delivery and parity (i.e., the birth order of the child) were examined as continuous variables based on preliminary analyses indicating linear relationships with SBA use. Paid employment was defined as a woman who had been employed for cash or in-kind in the last 12 months or not employed as a binary measure. Household wealth was determined based on reported ownership of household assets (e.g., consumer items and home attributes). A composite index was created by the DHS MEASURE that was based on the results of the principal component analysis and divided into quintiles [46]. Marital relationship was assessed as categorical, including monogamous union, polygamous as a first wife, or polygamous as a second wife or lower, to consider differences according to the type of relationship and wife order given evidence of differences in women’s status and power across these relationship types [48–50]. Household relationship, which was a binary variable, indicated if the respondent was a household head or not. The genders of children was a binary measure to assess if the respondent had at least one living son or not at the time of the delivery, as having a son has been shown to be an important reflection of African women’s status and power [51]. The place of residence was a binary measure and indicated whether the respondent lived in an urban or rural area. Women’s age relative to husbands was assessed as continuous, whereas relative education was examined as a categorical variable.

Perceived difficulty in accessing health care was also included as a control variable and included items such as getting permission to go, getting the money needed for advice or treatment, distance to a health facility, or not wanting to go alone. The variables were first recoded into binary variables to demonstrate whether 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 aspects for which the respondent perceived difficulties (scored 0–4).

Analytical models and steps
Data analysis was conducted in three main steps. First, descriptive analyses were conducted using SAS 9.3. Second, factor analyses were conducted using Mplus version 7.3 with a geomin rotation. Exploratory factor analysis (EFA) identified the number of factors/latent constructs and the underlying factor structure of empowerment. Consequently, a three-factor confirmatory factor analysis (CFA) examined the appropriateness and generalizability of the measurement portion of the SEM through the examination of the fit statistics of the portion and the statistical significance of path coefficients using t-values [43]. In the CFA, the path of the first indicator is constrained to 1 (thus t value was not calculated), and the significance of t-values refers to unstandardized parameter values. Third, a SEM was conducted with Mplus using polychoric correlations for categorical variables to examine the pathways from women’s education to SBA use. All the analyses were conducted while accounting for individual weights, clusters (i.e., primary sampling unit), and sample strata using the survey analysis commands.

The SEM models analyzed five equations simultaneously for all five endogenous variables in the model and estimated standardized coefficients; thus, the SEM also provided an examination of the multidimensionality of empowerment and the relative importance of one dimension over others. These equations separately regressed SBA use, household decision-making power, attitudes towards violence, attitudes towards sex negotiation, and age at first marriage.
using probit regression with weighted least squares (WLSMV) for more precise coefficient estimates than logistic regression, especially for mediation analysis [52]. This SEM employed list-wise deletion with missing observations due to the negligible proportion of missing observations in the study sample.

In the model, all of the exogenous variables were designated as covarying due to the potential relatedness among exogenous variables. Additionally, the errors/disturbances of empowerment dimensions were all covarying due to the possible relatedness among the unobserved aspects of these constructs.

Model fit was assessed using recommended model fit indices, including root mean square error of approximation (RMSEA) < 0.06 (or less as a “close” fit) and a comparative fit index (CFI)/Tucker-Lewis index (TLI) with ≥ 0.95 [53]. Weighted root mean square residual (WRMR) (less than 0.90) was also calculated by Mplus for the models with categorical endogenous variables [54].

Results

Descriptive results

Half of the respondents used an SBA at their most recent birth (Table 1). On average, women scored in the mid-range of the scales, indicating moderate levels of household decision-making and gender norm attitudes. Women got married or started a union at a mean age of 18.3 years, and they had an average of five years of education. On average, these women gave birth around four children, and two in five women were employed for cash payment. The majority of these women lived in rural areas and were in a monogamous union (79% respectively).

Factor analysis results

The exploratory factor analysis results defined three factors as follows (Eigenvalues >1.0) (Pett, 2003): 1) “household decision-making power” (three indicators); 2) “attitudes towards violence” (five indicators); and 3) “attitudes towards sex negotiation” (two indicators) (See Table 2). The three factors were shown to be significantly correlated, albeit not very highly, with correlation less than 0.25 (p < 0.05), which suggests that each factor is distinct. The three factor confirmatory factor analysis results including fit statistics and t-values support the appropriateness and generalizability of the measurement portion of the SEM (See Table 2) (p < 0.001).

SEM results

The final adjusted SEM results are presented in Table 3 and Fig 2. The path coefficients are standardized, while the p-values are reported in the unstandardized metric by default. The model fit statistics (RMSEA, CFI/TLI, WRMR) support that the models fit the data well.

Women’s education and household decision-making power were positively related to SBA use (Column 5 in Table 3) (i.e., the standardized coefficient for education = 0.121 and decision-making = 0.080)]. However, age at first marriage and perceptions of gender norms were not significant predictors of SBA use.

Additionally, age, urban residence, and higher household wealth were positively related to SBA use. Parity, having living son(s), being in a polygamous union, and perceived difficulties in accessing health care were negatively associated with SBA use. Education was positively related to age at first marriage (b = 0.177, Column 1 in Table 3). Other significant and positive covariates for predicting age at first marriage included women’s older age, being the second or lower rank wife in a polygamous union, and a husband’s higher education relative to women. However, parity, having son(s), and being the first wife in a polygamous union were negatively related to age at first marriage.
Education was positively associated with household decision-making power (b = 0.132), progressive attitudes towards violence (b = 0.086), and sex negotiation (b = 0.225) (Column 2–4, Table 3). As shown in Column 2, higher education, older age, paid employment, being head of the household and having son(s) were positively related to decision-making, whereas higher parity and polygamous relationships were negatively related.

In Column 3 (Table 3), significant covariates in predicting attitudes towards violence included higher education, older age, lower parity, paid employment, and a lower wealth quintile. Additionally, higher education, paid employment and being head of the household were
positively related to progressive attitudes towards sex negotiation, whereas a polygamous marital relationship as a second or lower wife order was negatively related (Column 4).

The direct and indirect effects of women’s education on SBA use are shown in Table 4. The total indirect effects of education on SBA use were significant via the identified multiple pathways. However, only the specific indirect effect through household decision-making power was significant. This outcome suggests that women’s higher education positively affected decision-making power, which in turn increased SBA use. This specific indirect effect of education \( (b = 0.011) \) contributes to the majority of the indirect effect with a substantial proportion of the total indirect effect relative to the direct effect (17.4%).

Discussion

This study investigated the mechanism through which women’s status and empowerment affect SBA use during childbirth in Tanzania. The findings demonstrated evidence of the multiple and sequential effects of women’s status and empowerment, such as direct, indirect and mediating effects. This evidence underscores the contribution of education on SBA use through multiple and sequential empowerment pathways and demonstrates the potential causal mechanisms influencing SBA use. This study also confirmed the multidimensional and contextual nature of empowerment as it relates to maternal health care use.

Five key findings arise from this analysis. First, the study showed the significant and positive direct effect of women’s education on age at first marriage, decision-making power, and progressive gender norm attitudes and SBA use. These findings are generally consistent with existing evidence on women’s education and other sociodemographic characteristics as predictors of delivery care use and outcomes [8, 14–20, 29–33].

As hypothesized per the integrated conceptual framework, the effects of education on delivery care use were mediated through women’s decision-making power. The positive influences of education and household decision-making power on SBA use align with some of the existing global evidence that women’s status and decision-making power are a key determinant of delivery care use as well as other reproductive health behaviors and outcomes [6, 10–12, 22]. These specific direct and indirect pathways were examined in a previous study conducted in Senegal by the authors; however, the significant dimensions of empowerment differed in Senegal such that attitudes towards gender norms were a significant mediator, instead of decision-
Both studies suggest potential causal pathways through which education may positively influence some empowerment domains and subsequent delivery care use. This evidence calls for policy makers and practitioners to further invest in women’s education for the dual purpose of empowering women for gender equality and of positively influencing maternal health outcomes [4, 35, 55, 56].

Second, the significant mediating effects of decision-making power on SBA use also highlight the importance of this construct in measuring women’s empowerment in general and for examining the shifts in household structure in Tanzania from predominantly extended to nuclear households [48, 49]. With an increasing proportion of households consisting of nuclear families in Tanzania and other global settings [48, 49, 57], women’s ability to participate in decisions becomes an increasingly important marker of their continued, or perhaps even expanded, engagement in decisions in the household amidst these broader social changes.

Table 3. Standardized path coefficients of the latent variable SEM (n = 4,340 for the analysis), TDHS 2010.

| Predictors in the equation (X): | [Column 1] | [Column 2] | [Column 3] | [Column 4] | [Column 5] |
|--------------------------------|------------|------------|------------|------------|------------|
| Age at first marriage          | 0.177***   | 0.132***   | 0.086**    | 0.225***   | 0.121***   |
| Decision-making power          | 0.908***   | 0.194***   | 0.136**    | 0.013      | 0.181***   |
| Attitudes towards violence     | -0.804***  | -0.111*    | -0.132**   | -0.045     | -0.211***  |
| Attitudes towards sex negotiation | -0.015       | 0.062**    | 0.083***   | 0.055*     | 0.046      |
| Education                      | 0.177***   | 0.132***   | 0.086**    | 0.225***   | 0.121***   |
| Age at childbirth              | 0.090***   | 0.194***   | 0.136**    | 0.013      | 0.181***   |
| Parity                         | -0.804***  | -0.111*    | -0.132**   | -0.045     | -0.211***  |
| Employment for payment         | -0.015       | 0.062**    | 0.083***   | 0.055*     | 0.046      |
| Household head                 | 0.003      | 0.099***   | -0.019     | 0.068**    | 0.005      |
| Urban residence                | 0.013      | 0.031      | -0.047     | 0.030      | 0.152***   |
| Having son(s)                  | -0.051**   | 0.055*     | 0.002      | 0.006      | -0.070**   |
| Household wealth (the 2nd lowest) | 0.017      | -0.033     | 0.065*     | 0.020      | 0.014      |
| Household wealth (the 3rd lowest) | 0.010      | -0.050     | 0.000      | 0.034      | 0.080**    |
| Household wealth (the 4th lowest) | -0.026    | -0.091*    | 0.039      | 0.039      | 0.150**    |
| Household wealth (the highest) | 0.002      | 0.006      | 0.239***   | 0.084      | 0.289***   |
| Polygamous union as a first wife | -0.057**   | -0.060**   | -0.023     | -0.018     | -0.061**   |
| Polygamous union as a second or lower | 0.036*   | -0.117***  | -0.001     | -0.069**   | -0.065**   |
| Relative age                   | 0.064***   | 0.036      | 0.022      | 0.011      | 0.001      |
| Less education than husband    | 0.062**    | 0.032      | 0.047      | 0.052      | 0.038      |
| More education than husband    | 0.031      | -0.025     | 0.007      | 0.033      | -0.032     |
| Perceived difficulty in accessing health care |          |            |            |            | -0.121***  |

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

Reference groups: residence = rural; household wealth = the lowest; marital relationship = monogamous union; relative education = almost the same education with husbands. DF = 169, RMSEA = 0.013, CFI = 0.993, TLI = 0.989, WRMR = 0.849. R-square: 0.367 (age at first marriage), 0.087 (decision-making), 0.090 (perceptions against violence), 0.101 (perceptions for sex negotiation), 0.395 (SBA use).

https://doi.org/10.1371/journal.pone.0212038.t003

making power as shown in this analysis in Tanzania. [41]. Both studies suggest potential causal pathways through which education may positively influence some empowerment domains and subsequent delivery care use. This evidence calls for policy makers and practitioners to further invest in women’s education for the dual purpose of empowering women for gender equality and of positively influencing maternal health outcomes [4, 35, 55, 56].
Third, the factor analysis results stressed that the construct of household decision-making was best represented by all three broader indicators of women’s decision-making power (i.e., own health care, household purchases, visits to family and relatives), and not limited to women’s ability to seek their own health care. The relevance of all three measures in predicting SBA use highlights the importance of looking more holistically at the components of household decision-making and their effects on the process of seeking and obtaining health services, especially in the context of Tanzania and elsewhere, where women’s roles are undergoing a transition. As noted by other scholars, the decisions on health care seeking, particularly in a resource-constrained setting, is complex and contingent upon multiple logistical and structural factors, such as the distance to facility, and the availability and quality of care [6, 10, 13].

Following the earlier advancement of gender perspectives and interventions to transforming gender norms and relationship in other reproductive health programs [58–60], the findings...
from this study emphasize the importance of maternal health interventions that seek to promote equitable gender relations and decision-making dynamics among couples and in the household.

Fourth, the use of SEM in this analysis provided the simultaneous comparison of several empowerment domains on SBA use, which reveals variations in the magnitude and significance of each domain. Two specific insights garnered from the SEM, including the null effects of age at first marriage and gender norm attitudes on SBA use in terms of both direct and mediating effects, were unexpected. These findings are in contrast to those of other studies that demonstrated significant effects of gender attitudes on SBA use in other African settings [15–17, 20, 41], including the findings from Senegal [20, 41]. These findings may reflect the ongoing transitions in social norms regarding gender relations and marriage in Tanzania [48, 49]. To address the complex nature and mechanisms through which women’s empowerment may influence various reproductive and maternal health outcomes, especially within dynamic social settings, it is critical to generate evidence, especially through implementation research, to enhance women’s status and empowerment in an effort to achieve health and broader development goals [13, 23, 55, 56].

The multidimensionality of empowerment is affirmed by the varied effects of the respective empowerment domains on SBA use; hence, there is a need for multidimensional operationalization and measurement of women’s status and empowerment. Furthermore, given that SEM provides an opportunity to examine these dimensions as latent constructs, it was possible to consider the contribution of each indicator and the respective measurement errors. Indeed, the residuals for these three factors (i.e., empowerment domains) were significantly correlated with each other, which suggests that there may be similar or shared features in the unexplained aspects of these latent variables. SEM is uniquely equipped to address such complexities and to measure and deconstruct intervening effects, although the empirical applications of SEM to such data are still limited in the literature.

Finally, findings from this study both align with and deviate from those of previous studies examining the influences of sociodemographic characteristics on SBA use. For example, consistent with previous reviews and renewed concerns regarding the provision of equitable maternity care [13], household wealth and urban residence were positively associated with

---

Table 4. Summary of standardized direct and indirect effects of education on SBA use (n = 4,340), TDHS 2010.

|                      | coefficient | t value |
|----------------------|-------------|---------|
| Total effect         | 0.143       | 5.212***|
| Direct effect        | 0.121       | 4.326** |
| Total indirect effect| 0.021       | 2.430*  |
| Indirect effect via  |             |         |
| Age at first marriage| 0.001       | 0.220   |
| Decision-making power| 0.011      | 2.335*  |
| Attitudes towards violence | 0.000  | -0.144   |
| Attitudes towards sex negotiation | 0.010 | 1.239     |
| Age at first marriage then decision-making power | 0.000 | 0.256     |
| Age at first marriage then attitudes towards violence | 0.000 | 0.070     |
| Age at first marriage then attitudes towards sex negotiation | 0.000 | 0.145     |

Note

***p <0.001
**p<0.01
*p<0.05.

https://doi.org/10.1371/journal.pone.0212038.t004
SBA use, and perceived difficulty in accessing health care was negatively related to SBA use [6, 10]. On the other hand, the null finding from this study regarding paid employment can be compared to cross-national studies in Africa that have found mixed evidence of women’s employment as a marker of women’s empowerment/status [15, 20, 29], and the results caution against the presumption that employment connotes higher status/power across contexts [61].

Despite the strengths of this study, there are some limitations. First, any causal inference is tentative due to the cross-sectional survey dataset that was employed. Therefore, despite the strength of SEM, the direction of causation remains uncertain due to potential reciprocal effects (e.g., school girls might have dropped out due to marriage or pregnancy; however, the hypothesized direction is supported by relevant theories and descriptive results. 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 informed by the data availability in the DHS, while the relevance of empowerment measures has not been highly supported in Africa to a greater extent than in Asia, where the measures were developed [27]. Third, the representativeness of the study sample and generalizability of the results are limited due to the omission of unmarried women, whereas measures of women’s power should ideally capture “strategic life choices” that are relevant regardless of marital status [21, 44]. The omission of young adolescents from the survey respondent is a serious gap given the evidence of risks and burdens carried by adolescents regarding unskilled deliveries, unsafe abortions, and maternal deaths [35, 62–65].

This study, however, is one of the first theory-based studies that uses nationally representative data to investigate complex mechanisms through which women’s status and empowerment affect SBA use during childbirth. This evidence affirms the multi-dimensionality of empowerment and its mediating role in the mechanism leading to professional delivery care. This finding calls for further investment in evidence-based policies and interventions in Tanzania, and possibly in other African countries, to increase education among women, to intensify legal and societal efforts to end child marriage and to facilitate women’s participation in household decision-making in an effort to promote SBA use and to achieve maternal and newborn mortality reductions.

Acknowledgments

The authors acknowledge the input and helpful suggestions of Peter M. Bentler, Anne R. Pebbley, Linda B. Bourque, and Patrick Heuveline; the UCLA Institute for Digital Research and Education; the Macro International that conducted the Tanzania Demographic and Health Surveys.

Author Contributions

Conceptualization: Kyoko Shimamoto.
Data curation: Kyoko Shimamoto.
Formal analysis: Kyoko Shimamoto.
Methodology: Kyoko Shimamoto.
Writing – original draft: Kyoko Shimamoto.
Writing – review & editing: Kyoko Shimamoto, Jessica D. Gipson.
References

1. WHO. Trends in maternal mortality: 1990 to 2015. Estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division. Geneva: WHO press, 2015.
2. Hug L, Sharrow D, You D. Levels & trends in child mortality: Report 2017. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2017.
3. WHO. Making pregnancy safer: the critical role of the skilled birth attendant: a joint statement of WHO, ICM, and FIGO. Geneva: WHO press, 2004.
4. United Nations. The Millennium Development Goals Report 2015. New York: United Nations, 2015.
5. United Nations. The Sustainable Development Goals Report 2018. 2018.
6. Kobislyn M, Matthews Z, Hussein J, Mavalankar D, Mradh MK, Anwar I, et al. Maternal Survival 3—Going to scale with professional skilled care. Lancet. 2006; 368(9544):1377–86. https://doi.org/10.1016/S0140-6736(06)69382-3 WOS:000241388100034. PMID: 17046470
7. Bhutta ZA, Das JK, Bahl R, Lawn JE, Salam RA, Paul VK, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? The Lancet. 2014; 384(9940):347–70.
8. Shiffman J. Can poor countries surmount high maternal mortality? Studies in Family Planning. 2000; 31(4):274–89. https://doi.org/10.1111/j.1728-4465.2000.00274.x WOS:000166404400002. PMID: 11198065
9. Ronsmans C, Graham WJ, Lancet Maternal Survival S. Maternal survival 1—Maternal mortality: who, when, where, and why. Lancet. 2006; 368(9542):1189–200. https://doi.org/10.1016/S0140-6736(06)69380-X WOS:000240916000031. PMID: 17011946
10. Thaddeus S, Maine D. TOO FAR TO WALK—MATERNAL MORTALITY IN CONTEXT. Social Science & Medicine. 1994; 38(8):1091–110. https://doi.org/10.1016/0277-9536(94)90226-7 WOS: A1994NC18000009.
11. Malhotra A, Shuler SP, Boender C. Measuring women’s empowerment as a variable in international development. World Bank workshop on poverty and gender: New perspectives; Washington D.C. 2002.
12. Tuncalp O, Souza J, Hindin M, Santos C, Oliveira T, Vogel J, et al. Education and severe maternal outcomes in developing countries: a multicountry cross-sectional survey. BJOG: An International Journal of Obstetrics & Gynaecology. 2014; 121(s1):57–65.
13. WHO. Strategies towards ending preventable maternal mortality (EPMM). 2015.
14. Ahmed S, Creanga AA, Gillespie DG, Tsui AO. Economic Status, Education and Empowerment: Implications for Maternal Health Service Utilization in Developing Countries. Plos One. 2010; 5(6). e11190 https://doi.org/10.1371/journal.pone.0011190 WOS:000279135400006. PMID: 20585646
15. Singh K, Bloom S, Brodish P. Influence of gender measures on maternal and child health in Africa. MEASURE Evaluation Technical Report 66. 2011.
16. Singh K, Bloom S, Haney E, Oluronusiye C, Brodish P. Gender factors and facility delivery: Nigeria and MDG5. African Journal of Reproductive Health. 2012; 16:122–8.
17. Singh K, Bloom S, Brodish P. Gender equality as a means to improve maternal and child health in Africa. Health care for women international. 2015; 36(1):57–69. https://doi.org/10.1080/07399332.2013.824971 PMID: 24028632
18. Woldemicael G, Tenkorang EY. Women’s Autonomy and Maternal Health-Seeking Behavior in Ethiopia. Maternal and Child Health Journal. 2010; 14(6):988–98. https://doi.org/10.1007/s10995-009-0535-5 WOS:000283361700020. PMID: 19882240
19. Austin A, Farohunda B, Langer A, Orobaton N. Trends in delivery with no one present in Nigeria between 2003 and 2013. International journal of women’s health. 2015; 7:345. https://doi.org/10.2147/IJWH.S75973 PMID: 25997265
20. Shimamoto K, Gipson JD. The relationship of women’s status and empowerment with skilled birth attendant use in Senegal and Tanzania. BMC Pregnancy and Childbirth. 2015; 15(1):154.
21. Kaber N, McFadden P, Amrmed S, Dominguez E, Saaadallah S. Discussing women’s empowerment—theory and practice. Sida studies no.3. Stockholm, Sweden: Sida, 2001.
22. Upadhyay UD, Gipson JD, Withers M, Lewis S, Ciaraldi EJ, Fraser A, et al. Women’s empowerment and fertility: A review of the literature. Social Science & Medicine. 2014; 115:111–20.
23. Bank World. World Development Report 2012: Gender Equality and Development. Washington D.C.: World Bank Publications, 2012.
24. Safilios-Rothschild C. Female power autonomy and demographic change in the Third World. In: Anker R, Buvinic M, Youssef NH, editors. Women’s roles and population trends in the Third World: Routledge; 1982.
25. Hindin M. The Influence of Women’s Early Childbearing on Subsequent Empowerment in sub-Saharan Africa: A Cross-National Meta Analysis. International Center for Research on Women Fertility & Empowerment Working Paper Series. 2012:003–2012.

26. Pandey S, Lama G, Lee H. Effect of women’s empowerment on their utilization of health services: A case of Nepal. International Social Work. 2012; 55(4):554–73.

27. Kishor S, Subaiya L. Understanding women’s empowerment: a comparative analysis of Demographic and Health Surveys (DHS) data. DHS Comparative Reports No. 20. Maryland: Macro International, 2008.

28. Upadhyay UD, Karasek D. Women's empowerment and achievement of desired fertility in sub-Saharan Africa. DHS working papers. No.80. 2010.

29. Woldemicael G. Do women with higher autonomy seek more maternal health care? Evidence from Eritrea and Ethiopia. Health care for women international. 2010; 31(7):599–620. https://doi.org/10.1080/0739931003599555 PMID: 20526926

30. Jayaraman A, Chandra sekhar S, Gebreselassie T. DHS WORKING PAPERS: Factors Affecting Maternal Health Care Seeking Behavior in Rwanda. No. 59. 2008.

31. Babalola S, Fatusi A. Determinants of use of maternal health services in Nigeria—looking beyond individual and household factors. BMC Pregnancy and Childbirth. 2009; 9(1):43. https://doi.org/10.1186/1471-2393-9-43 PMID: 19754941

32. Kitui J, Lewis S, Davey G. Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009. BMC Pregnancy and Childbirth. 2013; 13(1):40. https://doi.org/10.1186/1471-2393-13-40 PMID: 23414104

33. Ochako R, Fotsio J-C, Ikamaria L, Khasakhalah A. Utilization of maternal health services among young women in Kenya: Insights from the Kenya Demographic and Health Survey, 2003. BMC Pregnancy and Childbirth. 2011; 11(1):1. https://doi.org/10.1186/1471-2393-11-1 PMID: 21214960

34. Zere E, Oluwolode D, Kirigia J, Mwikisa C, Mbeeli T. Inequities in skilled attendance at birth in Namibia: A decomposition analysis. BMC Pregnancy and Childbirth. 2011; 11(1):34. https://doi.org/10.1186/1471-2393-11-34 PMID: 21569585

35. WHO. WHO guideline on preventing early pregnancy and poor reproductive health outcomes among adolescents in developing countries. Geneva: WHO press, 2011.

36. UNFPA. Motherhood in childhood: facing the challenges of adolescent pregnancy. The state of world population 2013. 2013.

37. Lee-Rife S, Malhotra A, Warner A, Glinski AM. What works to prevent child marriage: A review of the evidence. Studies in family planning. 2012; 43(4):287–303. https://doi.org/10.1111/j.1728-4465.2012.00327.x PMID: 23239248

38. Aganwala R, Lynch SM. Refining the measurement of women's autonomy: An international application of a multi-dimensional construct. Social Forces. 2006; 84(4):2077–98.

39. Palitto CC, O’Campo P. Community level effects of gender inequality on intimate partner violence and unintended pregnancy in Colombia: testing the feminist perspective. Social Science & Medicine. 2005; 60(10):2205–16. https://doi.org/10.1016/j.socscimed.2004.10.017 WOS:0002277779200005. PMID: 15748669

40. Do M, Kurimoto N. Women’s Empowerment and Choice of Contraceptive Methods in Selected African Countries. International Perspectives on Sexual and Reproductive Health. 2012; 38(1):23–33. https://doi.org/10.1363/3802312 WOS:0003029880700003. PMID: 22481146

41. Shimamoto K, Gipson JD. Examining the mechanisms by which women’s status and empowerment affect skilled birth attendent use in Senegal: a Structural Equation Modeling approach. BMC pregnancy and childbirth. 2017; 17(2):341.

42. Bollen KA, Noble MD. Structural equation models and the quantification of behavior. Proceedings of the National Academy of Sciences. 2011; 108(Supplement 3):15639–46.

43. Kline RB. Principles and practice of structural equation modeling: Guilford press; 2011.

44. Blumberg RL. A General Theory of Gender Stratification. Sociological Theory. 1984; 2:23–101.

45. Collins R, Chafer JS, Blumberg RL, Coltrane S, Turner JH. Toward an Integrated Theory of Gender Stratification. Sociological Perspectives. 1993; 36(3):185–216.

46. National Bureau of Statistics (NBS) Tanzania and ICF Macro. Tanzania Demographic and Health Survey 2010. Dar es Salaam, Tanzania: NBS and ICF Macro; 2011.

47. National Bureau of Statistics (NBS) Tanzania and ICF Macro. Tanzania Demographic and Health Survey 2015–2016. Dar es Salaam, Tanzania: NBS and ICF Macro; 2016.

48. McCloskey LA, Williams C, Larsen U. Gender inequality and intimate partner violence among women in Moshi, Tanzania. International family planning perspectives. 2005: 124–30.
49. Larsen U, Hollos M. Women’s empowerment and fertility decline among the Pare of Kilimanjaro region, Northern Tanzania. Social Science & Medicine. 2003; 57(6):1099–115.

50. Boye A-eK, Hill K, Isaacs S, Gordis D. Marriage law and practice in the Sahel. Studies in family planning. 1991:343–9. PMID: 1792674

51. Fuse K. Cross-national variation in attitudinal measures of gender preference for children: An examination of Demographic and Health Surveys from 40 countries. DHS Working Papers No 44. 2008.

52. MacKinnon D. Introduction to statistical mediation analysis. New York, NY: Taylor & Francis Group; 2008.

53. Hu L-t, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal. 1999; 6(1):1–55.

54. Yu CY, Muthen B, editors. Evaluation of model fit indices for latent variable models with categorical and continuous outcomes. annual meeting of the American Educational Research Association, New Orleans, LA; 2002.

55. Mason E, McDougall L, Lawn JE, Gupta A, Claeson M, Pillay Y, et al. From evidence to action to deliver a healthy start for the next generation. The Lancet. 2014; 384(9941):455–67.

56. Requejo JH, Bryce J, Barros AJ, Berman P, Bhutta Z, Chopra M, et al. Countdown to 2015 and beyond: fulfilling the health agenda for women and children. The Lancet. 2014.

57. Bongaarts J. Household size and composition in the developing world in the 1990s. Population studies. 2001; 55(3):263–79.

58. Pulerwitz J, Gortmaker SL, DeJong W. Measuring sexual relationship power in HIV/STD research. Sex Roles. 2000; 42(7–8):637–60.

59. Pulerwitz J, Barker G. Measuring attitudes toward gender norms among young men in Brazil development and psychometric evaluation of the GEM scale. Men and Masculinities. 2008; 10(3):322–38.

60. Interagency Gender Working Group. A summary report of new evidence that gender perspectives improve reproductive health outcomes. Washington, DC: Population Reference Bureau. 2011.

61. Women Kabeer N., Wages and Intra-household Power Relations in Urban Bangladesh. Development and Change. 1997; 28(2):261–302.

62. Bearinger LH, Sieving RE, Ferguson J, Sharma V. Global perspectives on the sexual and reproductive health of adolescents: patterns, prevention, and potential. The Lancet. 2007; 369(9568):1220–31.

63. Magadi MA, Agwanda AO, Obare F.O. A comparative analysis of the use of maternal health services between teenagers and older mothers in sub-Saharan Africa: Evidence from Demographic and Health Surveys (DHS). Social science & Medicine. 2007; 64(6):1311–25.

64. Neal S, Matthews Z, Frost M, Fogstad H, Camacho AV, Laski L. Childbearing in adolescents aged 12–15 years in low resource countries: a neglected issue. New estimates from demographic and household surveys in 42 countries. Acta Obstetricia et Gynecologica Scandinavica. 2012; 91(9):1114–8. https://doi.org/10.1111/j.1600-0412.2012.01467.x PMID: 22620274

65. Wellings K, Collumbien M, Slaymaker E, Singh S, Hodges Z, Patel D, et al. Sexual behaviour in context: a global perspective. The Lancet. 2006; 368(9548):1706–28.