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Examining the Causal Effect of Social Development on Maternal Mortality in Sub-Saharan Africa Using Partial Least Squares (PLS) Structural Equation Modeling (SEM)

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Abstract: The threat of a woman in a low-income economy dying due to pregnancy and childbirth-related complications during her lifetime is about 120 times higher than for a woman living in a high-income economy. Social factors are seen as important factors contributing to maternal mortality and the conceptual framework developed for the reduction of maternal mortality has found the need to include social factors in intervention for maternal mortality reduction. The objective of this study is to examine the effect of social development on maternal mortality in Sub-Saharan Africa by applying Sen's development theory and the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique. The result of the empirical analysis shows that social development has both direct and indirect effects on maternal mortality. The direct effect is greater than the indirect effect. The direct effect is the effect of social development on reproductive capability, and the indirect effect is the effect of social development on maternal mortality through reproductive capability and freedom. The result also reveals a direct and positive effect of economic and political development on social development. Social development has the greatest effect on maternal mortality, compared to all the other effects in the model. The result of the PLS-SEM analysis and the final model supports all the hypotheses for the study.

Keywords: Maternal Mortality, PLS-SEM, Sen's Theory, Sub-Saharan Africa, Social Development

1. Introduction

The death of a mother during pregnancy and after childbirth is a key population development challenge developing countries face since women are seen as the backbone of the family. Maternal mortality is a health variable that measures the differences between developed and less developed countries, and for this reason, it was seen as an important target for the Millennium Development Goals (MDG's) and a key indicator for Sustainable Development Goals (SDG's). According to the WHO report 2017, almost 808 women die daily as a result of complications due to pregnancy and childbirth. The threat of a woman from a low-income economy dying due to pregnancy and childbirth-related complications during her lifetime is almost 120 times more than that of a woman from a high-income economy [1].

Approximately, Sub-Saharan Africa and South Asia recorded 540 and 225 of these maternal deaths, respectively. The statistics from the World Health Organization (WHO) for 2017 report that in 2015, developing countries accounted for 99% (302,000) of the world's estimates of maternal deaths. Sub-Saharan Africa recorded over half of these maternal deaths, representing 66 percent (201,000). The same statistics reports indicate that 18 countries in Sub-Saharan Africa countries have high maternal deaths estimates ranging between 500 and 999 deaths per 100,000 live births [2]. Despite the commitment by governments and international organizations to eradicate maternal mortality, a reproductive health-related death, it continues to be a misfortune for Sub-Saharan Africa countries. The most worrying situation is that almost all the pregnancy and childbirth-related deaths which occur in low-income countries are preventable, thus, it

is necessary to undertake new measures to reduce the level of maternal deaths among women in Sub-Saharan African countries. Even though Behavioral scientists such as McCarthy and Maine [3], Thaddeus and Maine [4], and [5] have developed conceptual frameworks for analyzing the connection between high maternal mortality rates and inadequate health infrastructure, low skill birth attendant rates, the status of women in the community, the level of education and lack of information on pregnancy and childbirth-related complications contribute to high maternal mortality.

According to Mukami et al. [6], factors such as women's status in society, education, quality health care, and access if considered in maternal health intervention will contribute to low maternal mortality. Also, Shen and Williamson [7] have argued that communities where a woman has high social status, such as in terms of education, tend to have low fertility and maternal mortality rate. Okwan and Kovacs [8] also found that social determinants (economic and cultural) have a direct and indirect effect on maternal mortality. Ellen et al. [9] have also argued that social environment could also influence maternal mortality directly or indirectly. However, aside from these studies and conceptual frameworks developed for analyzing the link between maternal mortality and its determining factors, recent social scientists, such as Dejong [10] and Robeyns [11] have applied Amartya Sen's Development theory in reproductive health research and found that social development influences the level of maternal mortality through reproductive capability and freedom. Nevertheless, there is no single study on maternal mortality in the SSA region that has attempted to investigate the effect and causal relationship between maternal mortality and social development by applying the Amartya Sen's development theory to reproductive health, to understand the link between maternal mortality and social development and also to recommend policies based on its findings to address the high maternal mortality in the SSA region, which is contributed by poor social conditions. The purpose of this study is to propose a conceptual model for assessing the effects of social development on maternal mortality, as well as the causal relationship between these latent variables in the Sub-Saharan Africa region by using Amartya Sen's development theory as a theoretical background.

2. Literature Review

This section presents a summary of the three important conceptual models that have been used in maternal health research to recommend interventions for the reduction of maternal mortality. These conceptual models show the importance of social indicators reflecting social development as argued by Sen [14] in intervention for maternal mortality reduction. The three conceptual models which have been demonstrated to be the most effective in analyzing the interactions between maternal mortality and social-related factors are: the conceptual model for analyzing maternal, newborn mortality, and morbidity developed by UNICEF [5], the three phases of delay framework (Three Delayed Model) by Thaddeus and Maine [4] and the framework for analyzing maternal mortality determinants by McCarthy and Maine [3]. These conceptual models and the indicators they measure are presented in a table form. We chose to summarize the conceptual models in a table form for easy understanding. The summarized conceptual model captures the author (s) name and year of publication, name of the conceptual model, and description of factors included in the conceptual model.

2.1. Conceptual Framework Based on Amartya Sen's Theory

Scientific contributions to social and human development approaches and theories are many, and academic professionals, such as Amartya Sen and Al Haq, and social work scholar Brij Mohan have made an argument based on the human development theories, perspectives, and approaches Mohan [12, 13], Sen [14, 15] and Ulhaql [16]. Human development is defined by scholars, such as Haq, as a means to improve the human condition and also to broaden the choices of individuals [16]. Economists, such as Sen, also defined it as the process of enlarging a person's ''functioning and capabilities to function, the range of things that a person could do and be in her life,'' and further stressed the need to improve on people.

These conceptual frameworks for analyzing maternal mortality have shown the need to address the social factors at the individual, household, or community, and society level to reduce maternal mortality, especially in underdeveloped countries.

Well-being, freedom, and capability Mohanalsocl [17, 15, 18]. Apart from the argument by these scholars, Mohan also claimed that the result of human development should be centered on taking care of the inhabitants' actual life situation, their dignity, and maximum value of life [13]. However, one of the most important antecedents to a complete social change is to ensure that human development and social freedom are implemented in a situation that suits social and innovations policies [12]. There have been numerous discussions on the diverse comparative methods used in analyzing the relevance and applicability of human and social development, but this study focuses on Sen's theory with the current discussions on its applicability in the area of reproductive health, in this case, maternal mortality, with an emphasis on Sub-Saharan African countries.

2.2. Amartya Sen's Theory on Development

The theories on social and human development proposed by economics scholar Amartya Sen have been on the development agenda for developing countries since the late '80s. Notwithstanding, the productive changes, the United Nations Development Programmme (UNDP) has implemented the human development theory by Sen in their developmental programs since the 1990s [19]. Even though Sen's human and social development theory has been in the economic and development literature since the late 80s, there is still a lack of scientific studies that apply Sen's paradigm on social and

human development to the reproductive health of women in developing countries, such as Sub-Saharan Africa countries.

The social and human development theory by Amartya Sen can be seen as a detailed theoretical framework that outlines the causal relationships of an individual's well-being from a micro to a macro system with robust application to women's reproductive studies, such as maternal mortality. Sen explains in detail the application of his development paradigm to reproductive health, that is, in his case, maternal mortality. Sen argues that human beings should have the ability ''to achieve actual livings that one can have reason to value'' [18]. He further stated that people should be given options to choose from or what he termed as ''capability sets'' to attain what they strive to achieve [18]. He named it ''capability'' or ''freedom'' [18]. Sen also termed the well-being of people as real achievements to accomplish what they strive to attain. He defines achievement as ''how well is one's being'' or ''different things one may value doing or being'' [15]. Sen further explains that people's well-being could be put together to show their real achievements or the ''amount and the level of functions enjoyed by the individual'' [15]. He also defined capability or freedom as available options to choose from various existences or achievements. He refers to these variations as being equal to someone not eating (termed as well-being in his case) or because he/she lacks food (inadequate capability or freedom) or food is available but he/she chooses not to eat (decided to select other achievements from a preferred capability set) [18].

He further explains, based on his development paradigm, that every development aims to achieve well-being, and this can be done through the enhancement of freedom and capability. This can be done at the same time by enhancing well-being directly. He also stated that the aims of development are multidimensional and its set of components depends on each other, however, the rate of each component is influenced by the amount it contributes to human development; and the question is whether the increase in human development leads to human freedom and capability [17]. Sen emphasized that the components of social development when compared to other aspect of development such economic growth or political development, which are very key but more or less lead to human development or capability which intend contribute to well-being.

According to Sen, social development is a reflection of "social policies which comprises putting up of educational structures, social insurance, health care, social work and the building up of social relationship among various individuals in societies and the world" as a whole. He justified his argument by giving evidence to show that investment in social development strengths in poor societies brings about a better quality of life for the inhabitant [17]. He used the low infant mortality situation in Kerala, India, and the high infant mortality in China to conclude his argument by saying that variations in the infant mortality rate for these countries are due to the difference in the social development efforts in these two countries [14]. If we are to apply Sen's development model to reproductive health, which in our case is maternal mortality, then we can also argue that that reduction in maternal mortality is the preferred state of well-being we aim to achieve and freedom or capability in terms of reproductive health can reduce the rate of maternal mortality. We can also hypothesize based on Sen's theory that social development should improve reproductive freedom or capability and well-being. We can state that social development is key in terms of reproductive capability and reduction of maternal mortality levels. Again, other development components, such as economic and political development also influence reproductive capability and maternal mortality. This effect is through social development efforts. This study seeks to examine the causal relationship between maternal mortality and social development in Sub-Sahar Africa by using Sen's development theory as the theoretical underpinning for the study. In our model, we use economic and political development as control variables. The under-listed hypotheses are tested with capability/freedom in terms of reproductive health, in this case, maternal mortality.

1) Increasing the rate of social development will improve the rate of reproductive capability.
2) Increasing the rate of social development will decrease the rate of maternal mortality.
3) Increasing the rate of reproductive capability will decrease the rate of maternal mortality.

3. Methodology

3.1. Data Type and Sources

We investigate the objective of the study using secondary data drawn from the online database of World Development Indicators (WDI) of the World Bank [2019], WHO database, United Nations Development Programme (UNDP), Demographic Health Survey (DHS), and Economist Intelligence Unit (EIU) report. The dataset for the study is cross-sectional data for 34 sub-Saharan African countries for the period from 2008 to 2015. Our target is all the 47 countries in Sub-Saharan Africa, but due to lack of data on some of the variables targeted for the study, only 34 countries were included in the analysis.)The variables and their description are presented in Table A1.

3.2. Estimation Technique and Procedure

The study used PLS-SEM structural equation modeling techniques proposed by Wold [20] to assess the effects of the latent variables on maternal mortality. This estimation technique has three components: the structural model, the measurement model, and the weighting scheme. The use of PLS-SEM is appropriate for the study since it consists of factor analysis and regression analysis and does not impose distributional assumptions on the data set used. It also gives meaningful results in the case of a small sample size. In addition, it is also appropriate for predicting and exploring existing theory as employed by Daniela Halidini et al [40] to explore and predict the theory of Acceptance and Use of Technology (UTAUT2) and, at the same time, to integrate a new relation between latent variables of interest. The study

estimated the measurement model, the structural model, and the weighting scheme using the PLS-SEM algorithm. The fitness of the measurement or the outer model is evaluated using the internal validity of the model, which is measured by the composite reliability and average variance explained in the case of this study. The convergence validity of the specified model is assessed using discriminant validity. The discriminant validity of the PLS- structural equation model (SEM) can be assessed using the Fornell and Lacker criteria [21] and Heterotrait-Monotrait Ratio (HTMT) by Henseler, Ringle, and Sarstedt [22]. This study used the Fornell and Lacker criteria to assess the discriminant validity of the final model. In this case, we compared the square root of the average variance explained (AVE) for each construct with the correlation between the latent constructs [21]. The fitness of the structural model is evaluated using R^2, which accounts for the proportion of the given latent variable that can be explained by the other latent variables and the independent variables affecting it. The size and the significance of the path coefficient is measured using f^2 [23].

3.3. Model Specification and Estimation

The path model for the study is reflective as specified in Figure 1. In this case, the arrows are directed towards the boxes. The circle in the above figure represents the latent variables or constructs. The boxes are the indicator variables. The arrows pointing to the circles measure the causal relationship between independent or exogenous and the dependent or endogenous latent constructs (i.e., the structural model) represented by $\beta_{12}, \beta_{14}, \beta_{23}, \beta_{24}$, and β_{34}. The arrows pointing to the boxes measure the correlation between latent variables (LVs) and manifesting variables (MVs) or indicators (i.e., measurement model) represented by $X_1, \ldots\ldots, X_{14}$. The latent construct and their manifesting variables are presented in Table 1 below.

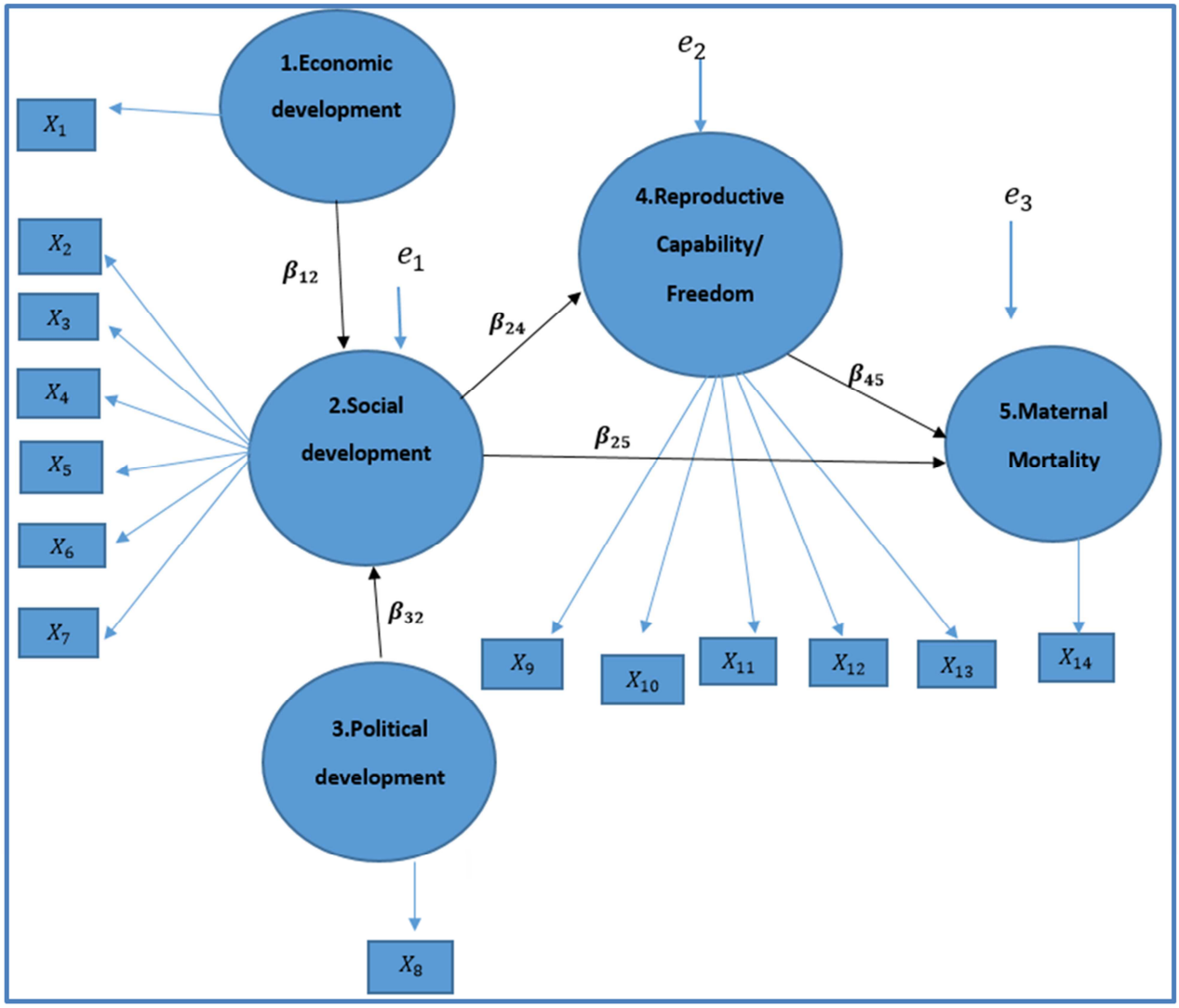

Figure 1. *Causal model for assessing the cause-effect of social development and maternal mortality.*

Source: Authors' own construction based on Sen's theory

Note. X_{1-14} *represents manifest variables;* e_1, e_2 *and* e_3 *are the error terms and the β-s are coefficients measuring the strength of the interactions between latent variables.*

Table 1. *Conceptual models for analyzing maternal mortality.*

Author(s) name and year of publication	Name of conceptual model	Description of conceptual model and factors included
UNICEF (2008)	Model for analyzing the causes of maternal and newborn mortality and morbidity	This model shows that in determining health outcomes, interrelated health determinants, such as nutrition, water, health delivery services, and behaviors, hygiene, and sanitation, disease control, social factors, and other health-related factors should be key. These health-related determinants are defined as proximate, which are classified as individual, categorized under household, community, or district; and basic as a society. The determinants for a particular stage of the framework affect other stages. neonatal and maternal health.
Thaddeus, S. & Maine, D (1994)	The Three Delay model	This conceptual model also recognizes the various obstacles women face in accessing effective and timely health assistance required to avoid the occurrence of pregnancy, postpartum, and death during childbirth. The authors have argued that three phases of delay in accessing sufficient healthcare are important determinants that account for about 75 percent of maternal deaths in low-income countries. These delays are linked to inadequate care to important factors, such as the delay in getting the needed by the individual or family, when the need arises (Delay1), delay in arriving at an equipped medical facility – transportation (Delay 2), delay in getting adequate care by the individual or family once at the medical facility (Delay 3)
McCarthy, J., Maine, D.(1992)	Conceptual model for analyzing determinant of maternal mortality and morbidity	This conceptual model also categorizes the determinants into three namely: (1) Distant (social, economic, and cultural) determinants which are measured by factors, such as a woman's status in her family and community, the status of her family in the community and the level of development in her community; (2) Intermediate determinants also measured by factors, such as the health status of the woman, her reproductive status, her access to health care services and her behavior and use; (3) pregnancy outcome (complication) which focuses on the reducing the probability of a woman becoming pregnant, reducing the risk of complication during pregnancy and reducing the outcome for pregnant women with complications

Source: Author(s)' own construction
Note: All the three conceptual models show the importance of including social factors reflecting social development in interventions for the reduction of maternal mortality

Table 2. *Latent constructs and their indicator variables (MVs).*

Latent construct	Manifesting variable
Maternal mortality construct	Maternal mortality ratio
Economic development construct	GNI per capita
Political development construct	Dem index
Social development construct	Access to an improved water source
	Public health expenditure
	Adult literacy rate
	Mobile phone users
	Internet users
	Human development index
Reproductive capability/freedom construct	Skilled birth attendant
	Contraceptive prevalence rate
	Antenatal care
	Early marriage
	One year old fully immunized

Note: GNI: Gross National Income; Demindex: Economists Intelligence Unit's Index of Democracy; HDI: Human Development Index
Sources: Authors' own construction

We estimated the latent construct for the model using equations (1) to (11) from Figure 1.

$$y_1 = y_1 + 0 \quad (1)$$

Where y_1 is Economic Development (exogenous variable)

$$y_2 = \beta_{12}y_1 + \beta_{32}y_3 + e_1 \quad (2)$$

Where y_2 represent Social Development (endogenous latent variable) and y_3 is Political Development (exogenous variable).

$$y_3 = y_3 + 0 \quad (3)$$

$$y_4 = \beta_{24}y_2 + e_2 \quad (4)$$

Where y_4 represent Reproductive Capability/Freedom (endogenous latent variable).

$$y_5 = \beta_{25}y_2 + \beta_{45}y_4 + e_3 \quad (5)$$

Where y_5 represent Maternal Mortality (endogenous latent variable). β_{12}, β_{24}, β_{25}, β_{32} and β_{45} represents the path coefficients. e_1, e_2 and e_3 are the error terms. We also estimated the total direct and total indirect effect of the latent constructs on Maternal Mortality using equations (6) to (15)

The total effect of Economic Development on Social Development

$$y_1 = \beta_{12} + 0 \quad (6)$$

The total direct effect of Political Development on Social Development

$$y_3 = \beta_{32} + 0 \quad (7)$$

The total direct effect of Social Development on Reproductive Capability/Freedom

$$y_2 = \beta_{24} + 0 \quad (8)$$

The total direct effect of Social Development on Maternal Mortality

$$y_2 = \beta_{25} + \beta_{24} * \beta_{45} \quad (9)$$

The total direct effect of Reproductive Capability/Freedom on Maternal Mortality

$$y_4 = \beta_{45} + 0 \quad (10)$$

The total indirect effect of Reproductive Capability/Freedom on Maternal Mortality

$$y_4 = \beta_{45} + 0 \quad (11)$$

The total indirect effect of Economic Development on Reproductive Capability/Freedom

$$y_1 = \beta_{12} * \beta_{24} \quad (12)$$

The total indirect effect of Political Development on Maternal Mortality

$$y_3 = \beta_{24} * \beta_{32} * \beta_{45} \quad (13)$$

The total indirect effect of Social Development on Reproductive Capability/Freedom

$$y_2 = \beta_{34} * \beta_{32} \quad (14)$$

The total indirect effect of Social Development on Maternal Mortality

$$y_4 = \beta_{24} * \beta_{45} \quad (15)$$

4. Results and Discussion

Figure 2 represents the results of the PLS algorithm. It shows the measurement model with the correlated values between the indicator and the latent construct. It also presents the results of the coefficient of determination (R^2) and the path coefficient between the latent constructs. The coefficient of determination (R^2) measures the overall effect size of the structural model. It is used in this case to represent the quality of the adjusted model. As indicated in Figure 2, 52.5% of the variation in the model is explained by social development, 53.3% and 16.2% by reproductive capability/freedom and maternal mortality, respectively. The variations in maternal mortality, explained by social development and reproductive capability are large. Based on the classification by Cohen [24], a coefficient determination (R^2) of 2% in social and behavioral science is classified as small, 13 percent as medium, and 26 percent as large. The results of the analysis on the coefficient of determination shows that political and economic development constructs explain 53.3% of the variations in the social determinants construct, 55.2% of the variations in reproductive capability/freedom is explained by social development, political and economic, and 16.2% of the variation in maternal mortality is explained by political, economic, social development and reproductive capability/freedom, respectively.

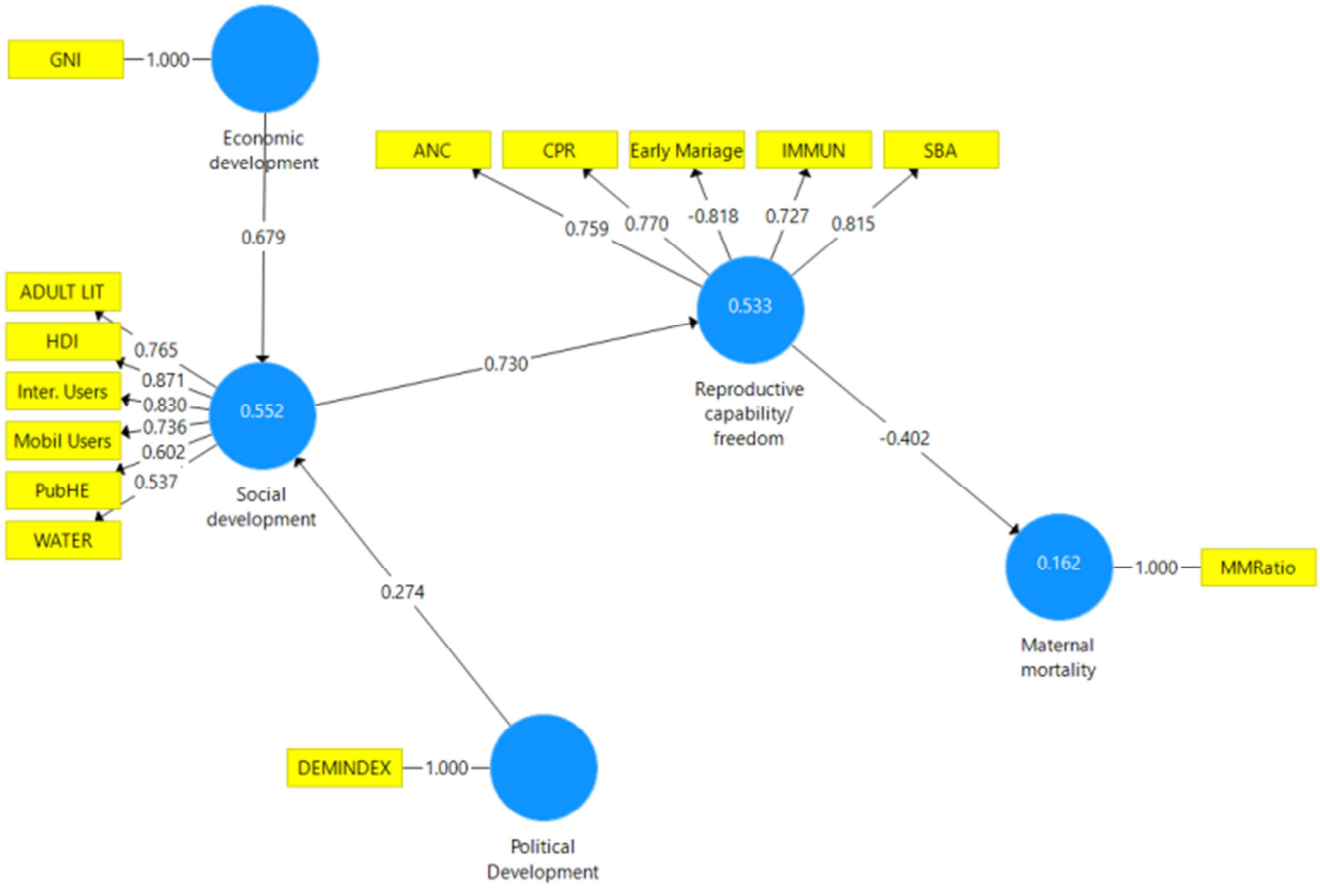

Figure 2. *Final causal model assessing the cause-effect of social development and maternal mortality in Sub-Saharan Africa.*

Note.; contraceptive prevalence rate (CRP); skilled birth attendant (SBA); antenatal coverage (ANC); human development (HDI) index; access to an improved water source (WATER); adult literacy (ADUL LIT); maternal mortality ratio (MMRatio); immunization (IMMUN: internet users (inter. Users); public health expenditure (PubHE); gross national income (GNI); economist intelligence unit's index of democracy (DEMINEX)
Source: Own estimation using smartPLS v.3.

The internal validity of our causal model is assessed using the composite reliability (CR), Average Variance Explained (AVE) as presented in Table 3. The reliability of our measurement model is assessed using the composite reliability, instead of the Cronbach's alpha, since it is the most appropriate for PLS estimation [25]. The composite reliability of our final model is greater than 0.7, showing that the construct of our model is adequate [22]. The convergent and divergent validity of our model exists, since the average variance explained by our model is greater than 0.5 as proposed by [26].

Table 3. *Indicator for the adjustment of validity of the final model.*

Latent Construct	Composite Reliability	Average Variance	R Square
Economic development	1.000	1.000	-
Maternal mortality	1.000	1.000	0.162
Political development	1.000	1.000	-
Reproductive capability/freedom	0.721	0.606	0.533
Social development	0.872	0.537	0.552

Source: Own estimation using smart PLS v.3.

The predictive validity and the effective predictive size of our final model are measured using the Stone-Geisser Indicator (Q^2), which assesses the model predictive quality, and Cohen's Indicator (f^2) , which also assesses the usefulness of each latent variable in the adjustment of the model. The result of the analysis based on the Blindfolding module of the PLS-SEM algorithm shows that the final model is accurate, and the latent constructs (reproductive capability/freedom, social development, and maternal mortality) are important for the overall adjustment of the model. The Cohen's Indicator (f^2) value of 0.389 for reproductive capability/freedom construct and 0.337 for social development social indicates a large effect (see Table 4). This means the effect of dropping these latent constructs from the final model is large.

Table 4. *Indicators validity and effective predictive size of the final model.*

Latent Construct	Validity (Q^2)	Effect size (f^2)
Economic Development	-	-
Maternal Mortality	0.137	-
Political Development	-	-
Reproductive Capability/Freedom	0.265	0.389
Social Development	0.249	0.337

Source: Authors' own estimation using smartPLS V3
Note. Evaluation criteria: $Q^2 > 0$; 0.02, 0.15, and 0.35 are considered small, medium, and large effects, respectively

The path coefficients are used in evaluating the hypotheses of the study. The significance of the path coefficients is tested using bootstrapping as proposed by Hair et al., [28]. The bootstrapping algorithm used a sub-sample of 5000 according to the assumptions of Hair et al. [29] to obtain the path coefficients for the latent construct. The results presented in Table 5 support the hypotheses for the study. The results showed a positive and statistically significant relationship between economic development and social development ($\beta = 0.697$, $p < 0.05$), political development and social development (($\beta = 0.274$, $p < 0.05$), and social development and reproductive capability/freedom ($\beta = 0.730$, $p < 0.05$) (see Table 5). The results also indicated a negative and statistically significant relationship between reproductive capability/freedom and maternal mortality ($\beta = -0.402$, $p < 0.05$). Thus, increasing reproductive capability by one unit will reduce maternal mortality by 0.402 unit. This also means, increasing reproductive capability, such as antenatal care, birth attended by skilled personnel, and contraceptive prevalence rate will reduce maternal mortality in the sub-Saharan Africa region. This result also supports the findings of previous studies conducted in the region [8, 30, 31] they found a direct relationship and effect of reproductive capability/freedom indicators on maternal mortality. In addition, [41] for contraceptive prevalence and birth attended by skilled personnel, indicators reflection reproductive capability/freedom will improve maternal health through education, which will also reduce maternal mortality as a maternal health outcome. The results further showed that increasing social development by a unit will increase reproductive capability/ freedom by 0.730 unit. This shows the importance of social development and how it is related to a woman's reproductive capability/freedom, such as having access to quality health care services [14].

Table 5. *Path coefficients of the final model.*

Path	Path Coefficients	Test Statistics	P-value
Economic Development → Social Development	0.697	7.941	0.000
Political Development → Social Development	0.274	1.996	0.046
Reproductive Capability/Freedom → Maternal Mortality	-0.402	3.231	0.001
Social Development → Reproductive Capability/Freedom	0.730	11.270	0.000

Source: Authors' own estimation using smartPLS V3

Table 6 presents the direct, indirect, and total effects of the latent constructs. The results showed that social development has a direct effect on reproductive capability/freedom ($\beta = 0.730$, $p < 0.05$). This is the greatest effect compared to all the

other direct effects in the model. This is followed by the direct effect of economic development on social development (β = 0.697, p <0.05) and reproductive capability/freedom on maternal mortality (β = -0.402, p <0.05) (i.e., negative). The effect of political development on social development is the lowest. The direct effects in the model are the same as the path coefficients between the latent constructs. The results further indicate an indirect effect of economic development on reproductive capability/freedom (β = 0.496, p <0.05), social development on maternal mortality (β = 0.274, p <0.05), and economic development on maternal mortality (β = -0.200, p <0.05), respectively. The indirect effects of economic development and social development on maternal mortality are negative. In absolute terms, the direct effect of economic development on reproductive capability/freedom (β = 0.496, p <0.05) is the greatest, followed by the effect of social development on maternal mortality (β = 0.274, p <0.05) and economic development on maternal mortality (β = -0.200, p <0.05) (see Table 5). The negative effect of indicators reflecting economic and social development on maternal mortality has been found in studies conducted by [32, 38, 39, 42]. The uniqueness of our results is that we can estimate the magnitude of the effects based on our estimation method.

The direct effect of social development on reproductive capability/freedom and maternal mortality shows that increasing the level of social development will increase reproductive capability/freedom and, in the long run, reduce the level of maternal mortality. This result supports the proposed hypothesis and findings of previous studies [8, 32]. They found that increasing social development indicators, such as public health expenditure, literacy rate, internet, and mobile phone usage, will improve antenatal care visits, increase conceptive rate, increase immunization, increase the number of birth attended by skilled personnel, and through these channels will reduce maternal mortality. The result indicates the importance of social development in the improvement of women's reproductive capability, and also contributes to the reduction of maternal outcome in the SSA region. The direct effect of economic development and political development on social development also indicates that these constructs are key in the improvement of social development to reduce maternal mortality in the sub-region. The result supports the argument that it is economic wealth that generates human well-being but not economic growth per se, but its enhancement through social development is what makes economic growth a key factor [14]. In addition, studies conducted by Almasi et al [35], Walker [36], Neal [37] also found the direct effect of indicators reflecting political and economic development, such as the Demindex and GNI per capita on maternal mortality.

The significant and indirect effect of social development on maternal mortality through reproductive capability/freedom reported in Table 6 supports Sen's paradigm that the basic aim of development is freedom, and he emphasizes that the purpose of every development is to achieve well-being, which can be done through the enhancement of freedom and capability [15]. He further explains the essence of the indirect effect of social development on human well-being through capability/freedom [14]. These results give evidence of the need to improve social development in the SSA region to reduce maternal mortality through reproductive capability/freedom, as argued by Sen.

Table 6. *Decomposed causal effect of the final model.*

Path	Direct	Indirect	Total
Economic Development → Maternal Mortality		-0.200*	-0.200
Economic Development→ Reproductive Capability/Freedom		0.496*	0.496
Economic Development → Social Development	0.679*		0.679
Political Development → Maternal Mortality		-0.081	-0.081
Social Development → Reproductive Capability/Freedom		0.200	0.200
Political Development → Social Development	0.274*		0.274
Reproductive Capability/Freedom → Maternal Mortality	-0.402*		-0.402
Social Development → Maternal Mortality		-0.294*	-0.294
Social Development → Reproductive Capability/Freedom	0.730*		0.730

Source: Authors own estimation using smartPLS V3
Note: *p<0.05

5. Conclusion and Policy Recommendations

The study investigated the effect of social development on maternal mortality in Sub-Saharan Africa by applying Sen's theory of development. The study used the PLS-SEM modeling approach and Sen's theory to examine the causal effect of social development on reproductive health, in this case, maternal mortality in Sub-Saharan Africa. The study sourced cross-sectional data for 34 Sub-Saharan African countries from international online databases, such as the World Health Organization (WHO), Demographic Health Survey (DHS), World Development Indicators (WDI) of the World Bank, Economist Intelligence Unit (EIU), and the United Nations Development Programme (UNDP) to validate the hypotheses for the study. The fitness of the structural and measurement model was verified. The outer model's (measurement model) fitness was assessed using composite reliability (CR), average variance explained (AVE), and discriminant validity. The results in Table 3 showed that the CR>0.5, AVE>0.7, and the square root of the average variance is greater than the correlation coefficient of each construct. This shows that the fitness of the structural model is validated. The fitness of the structural model was also

assessed using the coefficient of determination (R^2) (see Table 3), predictive validity (Q^2), and that the effect size (f^2) (see Table 4). The result in Table 3 showed that 53.3% of the variations in reproductive capability/freedom construct is explained by social development construct, economic development construct, and economic development constructs, 55.2% of the variations in social development construct is explained by economic development construct and economic development construct. The results show that maternal mortality is affected by four constructs, and they explain about 16.2% of the variations in the maternal mortality constructs. The results on the predictive validity of the structural model show that the latent constructs, maternal mortality, reproductive capability/freedom, and social development are accurate and important for the overall adjustment of the model. The results on the effective size of the model also showed that the latent construct reproductive capability/freedom and social development have a large effect on the model (see Table 4).

The results on the effect of the constructs in the model showed that social development has a direct effect on reproductive capability and an indirect effect on maternal mortality through reproductive capability (see Table 6. The direct effect of social development is greater than the indirect effect. The results call for more emphasis on social development in an area, such as education, health communication, and environment. Improving the adult literacy level, increasing basic social amenities, such as access to potable water and a clean environment, as well as increasing internet and mobile communication network will increase reproductive capability/freedom. The increase of resources in the health sector by training more health personnel, equipping health facilities with modern equipment, and increasing medical supplies will increase health care use and access. This, in effect, will improve reproductive/capability and freedom.

The results on the direct effect of political development and economic development have also shown the importance of economic development in the enhancement of well-being. The political development effect on social development shows that the likelihood of democratic government in the SSA region to engage in social development to reduce reproductive health in the case of maternal mortality is high. The results showed that good governance will increase health spending and also reduce maternal mortality [34]. The results support the arguments of Sen [15]. This result supports the finding of [33], who also saw the need not only to develop the political system in general but also the political willpower of women since it can contribute to the reduction of maternal mortality. These results have also confirmed the high maternal mortality in some Sub-Saharan African countries, such as Liberia and Sierra Leone, which have experienced political instability for a longer period. The political instability in these countries has affected the provision of social infrastructure necessary to improve the health system.

The results showed that all the hypotheses have been validated by the path analysis and the final model. The result also supports the applicability of Sen's theory in the investigation of the causal relationships between reproductive health, in this case, maternal mortality and social development in Sub-Saharan Africa. This indicates that increasing social development through reproductive capability/freedom will reduce the level of maternal mortality in the SSA region. The empirical analysis has shown that to reduce maternal mortality, governments in Sub-Saharan Africa should be engaged in social development projects in the area of health and education and also enhance the provision of basic social amenities for poor communities, where maternal mortality is high. The results of the study imply that social development alone is not enough, governments in the SSA region should also strengthen the democratic process in the region to promote economic growth which is made crucial through social development. The study also recommends to governments in the region that, aside from embarking on social development, good governance should also be a priority since it is key in maternal mortality reduction.

Appendix

Table A1. *Variables and their description.*

Variable	Description	Sources
Maternal Mortality Ratio (MMR)	The number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births.	WHO
Economic Development		
GNP per capita (Atlas method)	The total value of goods and services produced in a country (in US dollars) is divided by midyear. Population	WDI
Social Development		
Human development index	A composite index that measures overall well-being	UNDP
Public health expenditure	Public expenditure on health from domestic sources as a percentage of total public expenditure.	WDI
Adult literacy rate	Percentage of people above 15years who can read and write with understanding	WDI
Internet users	Percentage of people who have used the Internet from any location.	WDI
Mobile phone subscribers	The number of people per 1000 population that subscriptions to a public mobile telephone service that provide access to cellular technology	WDI
Access to an improved water source	The proportion of inhabitants using improved drinking water sources.	UNDP
Political Development		
Demindex	A measured based on five democratic areas: electoral process andpluralism; civil liberties; the functioning of government political participation and political culture.	EIU
Reproductive Capability/Freedom		

Variable	Description	Sources
Antenatal care coverage	Percentage of women aged 15–49 years that were attended at least once during pregnancy by skilled health personnel (doctor, nurse, or midwife).	DHS
Births attended by skilled health personnel	Percentage of births that received care from qualified medical personnel.	DHS
Access to an improved water source (%)	The percentage of the population using an improved drinking water source.	UNDP
Contraceptive prevalence rate (%)	The proportion of women currently using (or whose sexual partner) a particular method of contraceptive method at a point in time.	WDI
Early marriage (%)	Percentage of girls marriage before age 18	DHS
Immunization	The percentage of pregnant women who have received all vaccinations	DHS
Sources: Authors own construction		

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