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Research Article

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Random Intercept Multilevel Modeling of Determinants of Unintended Pregnancies in Sub-Saharan Africa

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Abstract

Background

Unintended pregnancies continue to be a significant public health concern in Sub-Saharan Africa, with adverse consequences for both maternal and child health. It has adverse effects on mental health, antenatal care, postnatal care, curative care, breastfeeding, child immunization, and infant mortality. Women with no or low income often face significant challenges in taking responsibility for an unintended child. This study aims to explore the determinants of unintended pregnancies in the region using a random intercept multilevel modeling approach to account for community based hierarchical structure of the data.

Methods

This study used secondary data from 29 sub-Saharan African countries, with a sample size of 50,539 pregnant women or women with at least one child. The data was extracted from the most recent Demographic and Health Survey conducted from 2006 to 2020 in SSA countries. A random intercept multilevel logistic regression model was fitted to the data to assess the association between the independent variables and unintended pregnancy, and the odds ratios (OR) with their 95% confidence intervals (CI) were duly reported.

Results

Nearly 24.0% of pregnancies were unplanned or unintended. In the random intercept multilevel model, women aged 21 years and above, specifically those in the age groups of 20-30 (Adj. OR= 0.674; 95% CI =0.6-0.76), 30-40 (Adj. OR=0.496; 95% CI =0.43-0.56), and 41 years and above (Adj. OR=0.273; 95% CI= 0.23-0.33), as well as women who adhere to traditional methods of contraceptive use (Adj. OR = 0.892; 95% CI = 0.81-0.98), women who are undecided about having children (Adj. OR = 0.854; 95% CI = 0.74-0.99), and women who no longer desire children (Adj. OR = 0.89; 95% CI = 0.83-0.95), have lower odds of unintended pregnancy. Additionally, women whose husbands make contraceptive decisions (Adj. OR = 0.806; 95% CI = 0.73-0.9), those who made joint decisions (Adj. OR = 0.948; 95% CI = 0.89-1.01), and those with decisions made by others such doctors on health grounds (Adj. OR = 0.634; 95% CI = 0.44-0.91) and women with higher education (Adj OR.=0.861; 95% CI= 0.74-1.01) also have lower odds of unintended pregnancy. On the other hand, women with primary education (Adj. OR = 1.245; 95% CI = 1.15-1.35), women with secondary education (Adj. OR = 1.354; 95% CI = 1.24-1.48), and women in households with more than two children, specifically 2-3 (Adj. OR =2.354; 95% CI =2.2-2.52), 4-6 (Adj. OR =2.532; 95% CI =2.17-2.96), and more than 6 children (Adj. OR =2.873; 95% CI =1.89-4.37), have higher odds of unintended pregnancies.

Conclusion

To address the unintended pregnancy in the SSA region, it is crucial to focus on teenagers or adolescents at the community level through regional and national family planning and maternal well-being policies and interventions. There is also a need to enhance reproductive health education and provide comprehensive education on modern contraceptive methods in secondary and tertiary education levels, specifically targeting young women.

Keywords: Prevalence, Determinants, Unintended Pregnancies, Random Intercepts, Sub-Saharan Africa

1. Introduction

The World Health Organization (WHO) defines unintended pregnancy as a pregnancy that was not desired or planned at the time of conception [1]. Unwanted or unintended pregnancies occur when individuals do not desire to have any children or do not want to have any more children [2]. Unplanned pregnancies are a common occurrence worldwide, with approximately 50% of conceptions resulting from 100 million acts of sexual intercourse being unplanned, and about 25% of pregnancies being unwanted [3]. Between 2010 and 2014, approximately 44% of pregnancies were unplanned, with a high prevalence of unintended pregnancy in developing countries. In this period, about 65 pregnancies per 1000 women in developing countries and 112 per 1000 in East Africa were unintended [4,5].

Unintended pregnancy is a significant public health problem in Africa, as evidenced by various studies conducted in the region, leading to consequences such as eclampsia, premature onset of labor, neonatal morbidity and mortality, and maternal mortality associated with abortion [6-9].The International Conference on Population and Development (ICPD) recognizes the right of couples to freely and responsibly decide the number and spacing of their children[7]. The high prevalence of unintended pregnancy in developing countries suggests a neglect of this fundamental right [10].

Low-income married women often face significant challenges in taking responsibility for an unintended child [8]. Unintended pregnancy has adverse effects on mental health, antenatal care, postnatal care, curative care, breastfeeding, child immunization, and infant mortality [11]. In countries where abortion is not legally allowed, unintended pregnancy can lead to complications related to abortion morbidity and mortality [8]. The increasing frequency of unplanned pregnancies can be seen as an indicator of women's autonomy in the decision-making process regarding having children [7]. However, there is limited published literature focusing on the determinants of unintended pregnancy in developing countries [12]. Studies conducted in various countries have shown that approximately 50% of pregnancies in the USA, 23% in Iran, 40% in Nepal, and 41% in Japan, are unintended [7,13,14].

Unintended pregnancies can have various causes, including contraception failure due to inconsistent or incomplete use of contraceptive methods, failure of family planning methods, and, less commonly, instances of rape and other factors [15]. Unintended pregnancies are widespread and can be attributed to various causes, including contraception failure due to inconsistent or incomplete use of contraceptive pills, failure of family planning methods to prevent pregnancies, and, less commonly, instances of rape and other factors. Therefore, addressing the issue of unplanned pregnancy is crucial and cannot be overlooked. Modeling the prevalence of unintended pregnancy in SSA will help to quantify the extent of unintended pregnancies in the population. This information is crucial for policymakers, healthcare providers, and researchers to assess the scale of the issue and allocate resources accordingly. Incorporating demographic, socioeconomic, and behavioral factors into the model would also help identify the risk factors associated with unintended pregnancy, aiding in understanding the causes and designing effective interventions to reduce unintended pregnancies in SSA. So far, very little work has been done in this regard in SSA.

Many studies have primarily focused on modeling factors associated with unintended pregnancy at the country level. However, there are few studies that have explored this topic for the entire Sub-Saharan Africa (SSA) region, and most of them have only focused on examining unintended pregnancy among young women aged 15-24 years. Additionally, the data collected by the Demographic and Health Surveys (DHS) is based on households, which constitute communities with distinct ethnic groups and varying characteristics such as standards, costs of living and other unobserved or unmeasured factors that are specific to each community. These diverse communities may have an impact on pregnancy intentions among women and across different communities. It is crucial to consider and incorporate this community variability into the model as a random intercept. Unfortunately, most studies in this field have only focused on individual levels of variation when identifying and modeling determinants related to unintended pregnancy. Therefore, the objective of this study is to model determinants of unintended pregnancy for all women of reproductive age (15-49 years) in SSA, taking into account community-level variation by including a random intercept in our model. This would be achieved by utilizing the most up-to-date data from the Demographic and Health Surveys conducted in 29 countries.

2. Methods

2.1 Data Source

The study utilizes data from the Demographic and Health Survey (DHS), a nationwide survey conducted every five years in low- and middle-income countries. The survey is representative of each country and collects information on various maternal and child health indicators, including unintended pregnancy, contraceptive use, and household characteristics. For this study, women's files were used, specifically focusing on responses from women aged 15 to 49. The dataset was obtained from the Measure DHS program after obtaining permission from http://www.dhsprogram.com. A total of 29 sub-Saharan African countries' most recent DHS datasets from 2006 to 2020 were included in the study.

The 29 sub-Saharan African countries included in the study are Angola, Benin, Burundi, Cameroon, Chad, Comoros, DR Congo, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Each country's survey consists of different datasets, including men, women, children, birth, and household datasets. For this study, the individual records dataset (IR file) containing data on women's health was used. The Demographic and Health Survey is conducted at five-year intervals and follows a standardized execution procedure in each country.

In each survey, a two-stage stratified sampling procedure was employed to select study participants. In the first phase, Enumeration Areas (EAs) were chosen based on the sampling frame specific to each country. In the second stage, a sample of households was selected from each EA. Eligible study participants were then interviewed within the selected households. The detailed description of the sampling procedure can be found elsewhere [16]. The women's files were extracted, merged, and utilized for the analysis in this study. During the analysis, sampling weights were applied using individual sample weights recorded in the dataset. This was done to generate reliable estimates by adjusting for over and under-sampled regions or enumeration areas.

2.2 Outcome Variable

The study focuses on the pregnancy intention of women aged 15-49 as the outcome variable of interest. This variable is determined based on the women's responses to questions regarding whether they planned their current pregnancy or their last child at the time of the survey. Women who reported planning to be pregnant or planning to have their last child (responding as "wanted" or "wanted then") were coded as zero (0), while those who did not intend to become pregnant (responding as "wanted later" or "not at all") were coded as one (1). Therefore, unintended pregnancy was coded as '1', and intended pregnancy was coded as '0' for further statistical analysis.

2.3 Covariates

This study considered several variables retrieved from the DHS datasets. These covariates included age, categorized as <21, 21-30, 31-40, and 41+ years. The number of children in the household was categorized as <2, 2-3, 4-6, and 7+ children. Employment status was classified as employed, unemployed, or uncertain. The number of household members was grouped as 1-3, 4-6, 7-9, and 10+ members. The sex of the household head was recorded as male or female. Religion was classified as Christian, Islam, Traditional, Others, No religion, or Unknown religion. Wealth index was categorized as poor, average, or rich. Educational status was recorded as no education, primary education, secondary education, or higher education. Contraceptive use was categorized as modern or traditional methods. Desire for children was classified as wants, undecided, or no more desire. Contraceptive decision maker was recorded as respondent, husband, joint decision, or others. Lastly, the country of residence of the respondent was also considered.

2.4 Statistical Analysis

Descriptive statistics were utilized to summarize the pregnancy intention of participants based on selected background and household-level characteristics of the respondents. Further analyses were conducted to explore individual and household-level factors that may be significantly associated with pregnancy intention among women aged 15-49. Additionally, the study examined unobserved community-level effects on the outcome.

After removing missing values that occurred in the outcome and critical predictor variables, a sample of 50,539 women was used in the modeling process. Both single-level and multilevel (mixed effects) logistic regression models were applied to the data, which consisted of 50,539 observations from 12,229 households or primary sampling units in 893 communities (strata) across twenty-nine Sub-Saharan African countries. The hierarchical structure of the dataset, with households and participants nested within communities, justified the extension from a single-level logistic regression model to a multilevel logistic regression model.

In this study, a random intercept multilevel logistic regression model was employed to investigate potential variations in pregnancy intention among women across different clusters or communities. This modeling approach allowed for the identification of potential risk factors while placing particular emphasis on community-level differences [17]. By using a multilevel modeling approach, the study aimed to assess the impact of community-level factors on pregnancy intention and to account for the nesting of unintended pregnant women within communities. This nesting effect cannot be adequately captured by a single-level logistic regression model.

We present the formulation of the multilevel logistic regression model, taking into account clustering in the data [18].

Let p_{ij} be the probability that individual i in community j has unintended pregnancy $\frac{p_{ij}}{1-p_{ij}}$ and be the odds of a woman i living in community j having an unintended pregnancy. The multilevel logistic model for the study is given as: $ln.\left(\frac{p_{ij}}{1-p_{ij}}\right)=\alpha+d(X_{ij})\beta+\eta_j+\varepsilon_{ij}$ Where is the average odds of the probability of women having unintended pregnancy across all communities without the contributive effect of any risk factor, $d(\bullet)$ is a vector of the predictor variables, β is a vector of regression coefficients of the predictor variables, η_j (community-level residual or variation in the log-odds of unintended pregnancy across the communities) and ε_{ij} is the residual error term for individual i in community j (individual-level residual), all assumed to follow a normal distribution with mean zero (0) and Constant variance.

To quantify the proportion of total variation attributable to between-community differences, the community-level variance partitioning coefficient (VPC) was employed. Assumed σ^2 is community-level variance, then VPC is estimated as (σ^2 / (σ^2 + individual-level variance))*100. Where the individual-level residual is assumed to follow standard logistic distribution with mean zero and variance $\pi^2/3$, where $\pi = 3.14$ [19,20]. However, the VPC is difficult to interpret because it is estimated on the log-odds scale. To address this, we computed the median odds ratio (MOR) as a measure or a quantification of variation in the communities or clusters. The MOR is preferred because it is easier to interpret and understand as it is expressed in terms of inter-community variance on the odds ratio scale based on which the effects of risk factors are also interpreted [21]. Thus, it represents the median value of the odds ratios calculated for all possible pairs of individuals from different communities while controlling for the fixed effects in the model. A MOR value greater than 1 indicates significant clustering or variation between communities, while a value close to 1 suggests minimal clustering or variation. σ^2 Given (the community-level variance), the MOR is estimated as follows:

$$MOR = \exp(\sqrt{2*\sigma}*\phi^{-1}(0.75))$$

Model parameters were obtained using maximum likelihood. Identity covariance structure provided a good fit to the data in the multilevel logistic model. The goodness of fit for the fitted models was examined using the Akaike information criterion (AIC), and Bayesian information criterion (BIC). Generalized variance inflation factor (GVIF) was used to check for multicollinearity, and GVIF value below 10 was considered acceptable [22]. All the analyses were performed using Stata 17.0. All analysis accounted for weighting, clustering, stratification and design effect using the survey mode in Stata ("svy") due to the complex survey design of the MIS (Malaria Indicator Survey) data [23]. Statistical significance was declared at 0.05 alpha levels.

2.5 Ethics Statement

This study was based on publicly available dataset from the measure DHS program. The dataset was obtained from the measure DHS program after permission was sought and subsequently granted through the site; http://www. dhsprogram. com. The most recent DHS datasets from 2006 to 2020 on twenty-nine (29) sub-Saharan African countries were used in this study. The study requires no ethical approval, since it did not directly involve contacts between the authors and the individuals interviewed.

3. Results

3.1 Unintended Pregnancy Distribution

Out of the 50,539 participants, the majority, 38,561 (76.67%), intended to become pregnant, while a significant number, 11,978 (23.70%), had no intention of becoming or having a child. There is a significant association between various factors, including the age of women, number of children in the household, employment status, number of household members, religion, wealth index, educational status, contraceptive use, desire for children, contraceptive decision maker, and country of residence, with the pregnancy intention of women.

The majority of women in the age group of <20 (30.17%) experience unintended pregnancies compared to women in other age categories. Additionally, a higher proportion of women living in households with 2-3 children (30.23%) have unintended pregnancies compared to women in households with other numbers of children, particularly those with <2 children. Moreover, a significant number of employed women (24.93%) have unintended pregnancies compared to the unemployed (23.22%) and those uncertain (22.04%) about their employment status **(Table 1).**

Items	Total	Intended	Unintended	P-value
Pregnancy intention	N = 50,539	N= 38561	N= 11978	
Age				0.000
<21	2444.00	1707(69.83)	737(30.17)	
21-30	27242.00	19917(73.11)	7325(26.89)	
31-40	17496.00	13985(79.93)	3511(20.07)	
41+	3357.00	2974(88.59)	383(11.41)	
Number of children in household(de jury)			0.000	
<2	25398.00	20842(82.06)	4556(17.94)	
2-3	22433.00	15652(69.77)	6781(30.23)	
4-6	2310.00	1754(75.91)	556(24.09)	
7+	398.00	310(77.91)	88(22.09)	
Employment status				0.003
Employed	14288.00	10726(75.07)	3562(24.93)	
Unemployed	36167.00	27769(76.78)	8398(23.22)	
Uncertain	84.00	65(77.96)	19(22.04)	
Number of household members				0.000
1-3	7533.00	5851(77.67)	1682(22.33)	
4-6	25131.00	18931(75.33)	6200(24.67)	
7-9	11495.00	8788(76.45)	2707(23.55)	
10+	6380.00	4996(78.30)	1384(21.70)	
Sex of household head				0.094
Male	42983.00	32865(76.46)	10118(23.54)	
Female	7556.00	5694(75.36)	1862(24.64)	
Type of pace of residence				0.498
Urban	17763.00	13596(76.54)	4167(23.46)	
Rural	32776.00	24965(76.17)	7811(23.83)	
Religion				0.000
Christian	33407.00	24731(74.03)	8676(25.97)	
Islam	8568.00	6991(81.60)	1577(18.40)	

African	243.00	183(75.49)	60(24.51)	
Others	355.00	267(75.10)	88(24.90)	
No religion	1150.00	981(85.27)	169(14.73)	
Unknown	6816.00	5413(79.42)	1403(20.58)	
Wealth Index				0.000
Poor	18291.00	13737(75.10)	4554(24.90)	
Average	10079.00	7571(75.12)	2508(24.38)	
Rich	22169.00	17225(77.70)	4944(22.30)	
Educational status				0.000
no education	10888.00	9010(82.75)	1878(17.25)	
Primary education	21536.00	15930(73.97)	5606(26.03)	
secondary education	15787.00	11719(74.23)	4068(25.77)	
Higher education	2328.00	1917(82.34)	411(17.66)	
Contraceptive use				0.000
Modern	45400.00	34509(76.01)	10891(23.99)	
Tradition	5139.00	4052(78.85)	1087(21.15)	
Desire for children				0.000
Wants	31402.00	23630(75.25)	7772(24.75)	
Undecided	1954.00	1537(78.65)	417(21.35)	
no more	17183.00	13392(77.94)	3791(22.06)	
Contraceptive decision maker				
Respondent	11817.00	9103(77.03)	2714(22.97)	0.000
Husband	4986.00	3943(79.08)	1043(20.92)	
joint	33404.00	25217(75.49)	8187(24.51)	
Others	332.00	296(89.04)	36(10.96)	
Country				0.000
Angola	688	425(61.75)	263(38.25)	
Benin	1385	1068(77.08)	317(22.92)	
Burundi	2247	1716(76.37)	531(23.63)	
Cameroon	1161	910(78.42)	251(21.58)	
Chad	381	240(62.89)	141(37.11)	
Comoros	301	209(69.52)	92(30.48)	
DR.Congo	1699	1245(73.30)	454(26.7)	
Gambia	1119	891(79.60)	228(20.40)	
Ghana	1007	760(75.50)	247(24.50)	
Guinea	554	495(89.39)	59(10.61)	
Kenya	2991	2224(74.34)	767(25.66)	
Lesotho	547	387(70.69)	160(29.31)	
Liberia	956	661(69.13)	295(30.87)	
Madagascar	3684	3493(94.82)	191(5.18)	
Malawi	6592	4565(69.25)	2027(30.75)	
Mali	1085	913(84.16)	172(15.84)	
Mauritania	1212	962(79.40)	250(20.60)	
Namibia	1034	741(71.71)	293(28.29)	
Niger	1358	1190(87.62)	168(12.38)	
Nigeria	1358	1190(87.62)	168(12.38)	
Rwanda	3478	2574(74.01)	904(25.99)	
Senegal	1176	1012(86.03)	164(13.97)	
Sierra Leone	1314	1132(86.12)	182(13.88)	
South Africa	746	556(74.54)	190(25.46)	

Tanzania	2127	1535(72.18)	592(27.82)	
Togo	1176	1012(86.03)	164(13.97)	
Uganda	3175	2153(67.82)	1022(32.18)	
Zambia	2953	2044(69.22)	909(30.78)	
Zimbabwe	3035	2296(75.64)	739(24.36)	

Table 1: Relationship between pregnancy intention and background Socio-economic Characteristics

Regarding religion, the majority of women belonging to Christianity (25.97%), African traditional religions (24.51%), and other religions (24.9%) experience unintended pregnancies. Furthermore, a higher proportion of women with poor wealth status (24.9%) and average wealth status (24.38%) have unintended pregnancies compared to those who are considered rich.

In terms of education, women with primary education (26.03%) and secondary education (25.77%) have a higher prevalence of unintended pregnancies compared to those with higher and tertiary education. Additionally, women who use modern contraceptives (23.99%), engage in joint decision making (24.51%), and have a desire for children (24.75%) also have a significant association with unintended pregnancies. **(Table 1)**

	single level logistic regression		**Multilevel Model**
ITEMS	**Crude. OR**	**Adj. OR**	**Adj. OR**
Age			
<20	**1(Reference)**		
20-30	0.851(0.76-0.95)**	0.69(0.61-0.78)***	0.674(0.6-0.76)***
30-40	0.581(0.52-0.65)***	0.514(0.45-0.58)***	0.496(0.43-0.56)***
41+	0.298(0.25-0.35)***	0.287(0.24-0.34)***	0.273(0.23-0.33)***
Number of children in household(de jury)			
<2	**1(Reference)**		
2-3	1.982(1.88-2.09)***	2.275(2.14-2.42)***	2.354(2.2-2.52)***
4-6	1.452(1.28-1.65)***	2.456(2.11-2.85)***	2.532(2.17-2.96)***
7+	1.297(0.88-1.9)	2.674(1.77-4.04)***	2.873(1.89-4.37)***
Employment status			
Employed	**1(Reference)**		
Unemployed	0.911(0.86-0.97)**	0.956(0.9-1.02)	0.948(0.89-1.01)
Uncertain	0.851(0.47-1.56)	0.774(0.41-1.44)	0.747(0.39-1.45)
Number of household members			
1-3	**1(Reference)**		
4-6	1.139(1.06-1.23)***	0.915(0.84-1)*	0.917(0.84-1)
7-9	1.071(0.98-1.17)	0.949(0.85-1.06)	0.951(0.85-1.06)
10+	0.964(0.87-1.07)	0.857(0.75-0.98)*	0.859(0.75-0.98)*
Sex of household head			
Male	**1(Reference)**		
Female	1.062(0.99-1.14)	1.024(0.95-1.1)	1.027(0.95-1.11)
Type of place of residence			
Urban	**1(Reference)**		
Rural	1.021(0.96-1.08)	0.952(0.88-1.03)	0.947(0.88-1.02)
Religion			
Christian	**1(Reference)**		
Islam	0.643(0.59-0.7)***	0.805(0.71-0.91)***	0.801(0.71-0.91)***
African	0.926(0.65-1.33)	1.318(0.9-1.92)	1.272(0.86-1.88)
Others	0.945(0.72-1.24)	0.933(0.7-1.24)	0.912(0.68-1.23)
No religion	0.492(0.4-0.6)***	1.038(0.84-1.28)	1.018(0.82-1.26)
Unknown	0.738(0.68-0.8)***	1.023(0.29-3.55)	1.036(0.29-3.66)
Wealth Index			
Poor	1(Reference)		
Average	0.999(0.93-1.07)	1.047(0.97-1.13)	1.049(0.97-1.13)

Rich	0.866(0.82-0.92)***	0.939(0.87-1.01)	0.932(0.86-1.01)
Educational status			
no education	1(Reference)		
Primary education	1.688(1.57-1.81)***	1.245(1.15-1.35)***	1.236(1.14-1.34)***
secondary education	1.665(1.54-1.81)***	1.354(1.24-1.48)***	1.349(1.23-1.48)***
Higher education	1.029(0.89-1.19)	0.861(0.74-1.01)	0.852(0.72-1)
Contraceptive use			
Modern	1(Reference)		
Tradition	0.85(0.78-0.93)***	0.892(0.81-0.98)*	0.885(0.8-0.98)*
Desire for children			
Wants	1(Reference)		
Undecided	0.825(0.72-0.95)**	0.854(0.74-0.99)*	0.859(0.74-1)
no more	0.861(0.81-0.91)***	0.89(0.83-0.95)***	0.882(0.82-0.95)***
Contraceptive decision maker			
Respondent	1(Reference)		
Husband	0.887(0.8-0.98)*	0.806(0.73-0.9)***	0.802(0.72-0.89)***
joint	1.088(1.02-1.16)**	0.948(0.89-1.01)	0.944(0.88-1.01)
Others	0.413(0.3-0.58)***	0.641(0.45-0.9)*	0.634(0.44-0.91)*
Country			
Angola	1(Reference)		
Benin	0.48(0.36-0.63)***	0.536(0.4-0.73)***	0.524(0.38-0.72)***
Burundi	0.5(0.39-0.64)***	0.571(0.43-0.75)***	0.557(0.42-0.74)***
Cameroon	0.444(0.33-0.6)***	0.432(0.31-0.59)***	0.412(0.3-0.57)***
Chad	0.953(0.66-1.38)	0.973(0.67-1.41)	0.891(0.6-1.32)
Comoros	0.708(0.47-1.07)	0.937(0.6-1.47)	0.9(0.57-1.43)
DR.Congo	0.588(0.44-0.78)***	0.569(0.42-0.77)***	0.551(0.4-0.76)***
Gambia	0.414(0.3-0.57)***	0.48(0.34-0.68)***	0.456(0.32-0.66)***
Ghana	0.524(0.39-0.7)***	0.613(0.45-0.83)**	0.601(0.44-0.83)**
Guinea	0.192(0.13-0.28)***	0.23(0.15-0.36)***	0.223(0.14-0.35)***
Kenya	0.557(0.43-0.72)***	0.63(0.48-0.83)***	0.619(0.47-0.82)***
Lesotho	0.669(0.49-0.91)*	0.906(0.65-1.26)	0.909(0.64-1.28)
Liberia	0.721(0.52-0.99)*	0.923(0.66-1.3)	0.927(0.65-1.33)
Madagascar	0.088(0.07-0.12)***	0.096(0.07-0.13)***	0.09(0.07-0.12)***
Malawi	0.717(0.57-0.91)**	0.807(0.62-1.05)	0.798(0.61-1.05)
Mali	0.304(0.23-0.41)***	0.365(0.26-0.51)***	0.341(0.24-0.48)***
Mauritania	0.419(0.31-0.56)***	0.373(0.1-1.35)	0.352(0.1-1.3)
Namibia	0.637(0.48-0.85)**	0.723(0.54-0.97)*	0.717(0.53-0.98)*
Niger	0.228(0.17-0.31)***	0.212(0.06-0.77)*	0.194(0.05-0.72)*
Nigeria	0.228(0.17-0.31)***	0.212(0.06-0.77)*	0.194(0.05-0.72)*
Rwanda	0.567(0.44-0.72)***	0.706(0.54-0.92)*	0.699(0.53-0.92)*
Senegal	0.262(0.19-0.37)***	0.326(0.22-0.48)***	0.311(0.21-0.46)***
Sierra Leone	0.26(0.19-0.35)***	0.366(0.26-0.51)***	0.347(0.25-0.49)***
South Africa	0.551(0.39-0.77)***	0.663(0.18-2.42)	0.648(0.17-2.42)
Tanzania	0.622(0.48-0.8)***	0.699(0.2-2.5)	0.683(0.19-2.49)
Togo	0.262(0.19-0.37)***	0.326(0.22-0.48)***	0.311(0.21-0.46)***
Uganda	0.766(0.6-0.98)*	0.804(0.62-1.05)	0.794(0.6-1.05)
Zambia	0.718(0.56-0.92)**	0.755(0.58-0.98)*	0.739(0.56-0.97)*
Zimbabwe	0.52(0.41-0.66)***	0.548(0.42-0.72)***	0.532(0.4-0.7)***
Random effect parameters			Estimates
Individual-level variance			

Community-level variance ( )		
Variance partitioning coefficient		6.29%
Median odds ratio (MOR)		1.56
ICC	-	0.063(0.052 - 0.077)
Model Selection		
AIC	50899.86	50767.84
BIC	51412.03	51288.84

Table 2: Binary Logistic Regression Results of Correlates of Unintended Pregnancy

Abbreviations: Adj. OR, adjusted odds ratio; CI, confidence interval; Crude OR, crude odds ratio, *Significant at 5%; **Significant at 1%; ***Significant at 0.1%; AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; ICC, intra-cluster Correlation Coefficient

3.2 Predictors of Unintended Pregnancies

The single-level logistic analyses identified Age, Number of children in the household, Employment status, Number of household members, sex of the household head, Religion, Wealth combined Index, Educational status, Contraceptive use, Desire for children, Contraceptive decision maker, and country of the respondent as significant factors influencing pregnancy intention. However, based on the values of the AIC and BIC model selection criteria, the multilevel model provided a good fit to the data compared to the single-level logistic regression model (Table 2). Hence, the random intercept multilevel logistic regression is preferred over the single-level multivariable model. We observed a moderate community-level residual of 0.221 (95% CI = 0.17-0.28), indicating that over 6.49% of the variance in the prevalence of unintended pregnancies could be attributed to community-level variations. The estimated median odds ratio (MOR), on the other hand, was calculated as 1.56, suggesting that the prevalence of unintended pregnancies varied significantly among communities, with a MOR 56% times higher than the reference (MOR=1).

The odds of unintended pregnancy decreased in the age groups 20-30 (Adj. OR= 0.674; 95% CI =0.6-0.76), 30-40 (Adj. OR=0.496; 95% CI =0.43-0.56), and 41 years and above (Adj. OR=0.273; 95% CI= 0.23-0.33) compared to women under the age of 20years. However, the odds of unintended pregnancy increased for households with 2-3 children (Adj. OR =2.354; 95% CI =2.2-2.52), 4-6 children (Adj. OR =2.532; 95% CI =2.17-2.96), and more than 6 children (Adj. OR =2.873; 95% CI =1.89-4.37) compared to households with less than 2 children. The odds of unintended pregnancies also increased among women who were unemployed (Adj. OR = 0.956; 95% CI = 0.9-1.02) and those uncertain about their job (Adj. OR = 0.774; 95% CI = 0.41-1.44) compared to employed women. Additionally, there was a decreased odds of unintended pregnancies in households with 4-6 members (Adj. OR = 0.915; 95% CI = 0.84-1.00), 7-9 members (Adj. OR =0.949; 95% CI = 0.85-1.06), and 10+ members (Adj. OR = 0.857; 95% CI = 0.75-0.98) compared to households with 1 to 3 members.

There is an increased odds of unintended pregnancy among women with average wealth (Adj. OR = 1.047; 95% CI = 0.97-1.13) and a decreased odds among rich women (Adj. OR = 0.939; 95% CI = 0.87-1.01) compared to women who are poor. The odds of unintended pregnancy also increased among women with primary education (Adj. OR = 1.245; 95% CI = 1.15-1.35) and secondary education (Adj. OR = 1.354; 95% CI = 1.24-1.48), but decreased among women with higher education (Adj OR.=0.861; 95% CI= 0.74-1.01) compared to women with no education.

The odds of unintended pregnancy decreased among women who adhere to traditional methods of contraceptive use (Adj. OR = 0.892; 95% CI = 0.81-0.98) compared to modern methods of contraceptive usage. Additionally, the odds decreased among women who were undecided about having children (Adj. OR = 0.854; 95% CI = 0.74-0.99) and women who no longer desired children (Adj. OR = 0.89; 95% CI = 0.83-0.95) compared to women who desired children. The odds also decreased among women whose husbands made contraceptive use decisions (Adj. OR = 0.806; 95% CI = 0.73-0.9), those who made joint decisions (Adj. OR = 0.948; 95% CI = 0.89-1.01), and those whose decisions were made by others (Adj. OR = 0.634; 95% CI = 0.44-0.91) compared to women who made the decisions themselves. Finally, 28 countries in the study had lower odds of unintended pregnancy compared to Angola (Table 2).

4. Discussion

The main focus of this study was to estimate prevalence and to develop a random intercept multilevel logistic regression model to determine triggering factors of unwanted pregnancy among women in Sub-Sahara Africa. Data on 50539 individuals from 29 Sub-Sahara Africa were analyzed to identify critical risk factors of unintended or unwanted pregnancy. In this study, unintended pregnancy prevalence of 23.70% was observed, suggesting that unintended pregnancy among women in Sub-Saharan African countries still remained a serious public health concern. The prevalence the prevalence in this study is higher than what was revealed in India (16.9%), Sri Lanka (17.2%) and South Asian countries (19.1%) [14,24,25]. However, it is lower than the prevalence in Pakistan (38.2%) [3].This difference could be attributed to the variation in intervention to reduce the unmet need for contraception, and unintended pregnancies among women which are critical components of family planning programs in developing countries [10].

Critical risk determinants independently associated with unintended pregnancy were the age of women, the number of children in the household, educational status, contraceptive use, desire for children, and the decision maker(s) for contraceptive use. We observed a moderate community-level residual, indicating that over 6.49% of the variance in the prevalence

of unintended pregnancies could be attributed to community-level variations. The estimated median odds ratio (MOR) was calculated as 1.56, suggesting that the prevalence of unintended pregnancies varied significantly among communities, with a MOR 56% higher than the reference group (MOR=1).

In this study, we found that odds of unintended pregnancy was higher among teenagers below the ages of 20years and decreased among older women. Consistent with a study in Tanzania where higher odds of unintended pregnancy was recoded among adolescents than older women. This outcome is similar to findings of studies in India and Ugandan [26-28]. This might simply be as a result of ignorance or limited in-depth knowledge about contraceptives use or birth control and knowledge on reproductive system on the part of adolescents. Also, unlike older women, teenagers are more likely to engage in unplanned sexual intercourse without protection possibly due to peer influence or desire for material gains [29].

In this study, there was a lower odds of unwanted pregnancy among women with Tertiary education but higher among women with primary and secondary education. This outcome is in line with earlier study among sub-Saharan African countries This trend can partially be due to the fact that there are more young and inexperienced adolescents at the primary and secondary level of education including unplanned sexual intercourse without any protection possibly due to peer influence or desire for material gains, accounting for higher prevalence of unintended pregnancy Africa [30-33].

Our study found high odds of unintended pregnancy among modern contraceptive users. It had been established that the use of modern contraceptive methods is one of the most effective ways to reduce the risk of unintended pregnancies [34]. However, other studies elsewhere, also found that traditional contraceptive use has a lower prevalence of unintended pregnancy than modern users [35,36]. This variance can be due to geographic and cultural dynamics.

Also, in our study women who are undecided or no more desire to have children tend to experience lower odds of unintended pregnancies than women who desire for children. Similar study in India confirmed that women who are undecided or no longer desire to have children tend to experience lower prevalence of unintended pregnancies than women who desire for children [37]. Economic and high cost of living could partly be the reason; Women who have already had two or more children may have reached their desired family size due to economic constraints [38]. The cost of raising children, including expenses related to education, healthcare, and basic needs, can be a significant factor in deciding not to have more children This observation might imply that women who desired for children do not make conscious effort to adopt measures of regulating their fertility so as to prevent unintended [39,40].

In this study there was higher odds of unwanted pregnancy among women who made contraceptive use decision than when decision is made by husbands or decision as may be determined by other factors such as decisions based on doctors' advice, which is consistent with the outcome of a study in Ghana by Ameyaw (Ameyaw, 2018). The finding of the study is also corroborated by other studies in Africa [15,41,42].

5. Conclusion

This study has made a significant contribution to the discourse on the wellbeing of mothers and children by uncovering the prevalence and determinants of unplanned pregnancy in sub-Saharan African (SSA) countries. Unintended pregnancy poses a major public health challenge in the region, and its high prevalence is influenced by multiple factors. The findings of this study revealed several variables that significantly contribute to unwanted pregnancy among women in SSA, including age, number of children in the household, educational status, contraceptive use, desire for children, and the decision-maker regarding contraceptive use. To address the issue of unintended pregnancy in the SSA region, it is crucial to focus on teenagers or adolescents at the community level through regional and national family planning and maternal wellbeing policies and interventions. Additionally, there is a need to enhance reproductive health education in primary schools and provide comprehensive education on modern contraceptive methods in secondary and tertiary education levels. This approach can help reduce unintended pregnancies, particularly among students in basic and secondary education.

Governments in sub-Saharan African countries, along with global and local stakeholders, should actively strive to achieve target 3.7 of the Sustainable Development Goals (SDGs) by 2030. This target aims to ensure universal access to sexual and reproductive healthcare services, including family planning, information and education, and the integration of reproductive health into national strategies and programs [43].

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