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Prevalence and Predictors of Unintended Births in Low and Middle-Income Countries: A Pooled Analysis of 27 Nationally Representative Surveys

Daniel Woytowich
Claremont Graduate University

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Approval of the Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Daniel Woytowich as fulfilling the scope and quality requirements for meriting the degree of Doctor of Public Health.

Paula Palmer, Co-Chair

Claremont Graduate University

Associate Professor of Community and Global Health

Bin Xie, Co-Chair

Claremont Graduate University

Professor of Community and Global Health

Jay Orr

Claremont Graduate University

Clinical Full Professor

Abstract

Prevalence and Predictors of Unintended Births in Low and Middle-Income Countries: A Pooled Analysis of 27 Nationally Representative Surveys

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Introduction

Rates of unintended births (UIBs) are disproportionately high in low- and middle-income countries (LMICs) where the capacity to provide care to unexpected mothers and their offspring is often lagging. To decrease the prevalence of UIBs and their negative impacts on children, women, families, communities, and health systems of developing nations, global health stakeholders must understand the characteristics of a woman's life in these regions that increase her risk for UIBs. This project identified and analyzed predictors of UIBs in Sub-Saharan Africa (SSA) and South-East Asia among all women of reproductive age. It built on findings from previous studies while also testing novel determinants in predictive models. The overall goal was to add to the conceptual understanding of sociodemographic, interpersonal, and family dynamic situations that predispose a woman to UIBs while factoring out overly specific regional influences. This can guide future research and inform public health practice in regions where comprehensive and context-specific studies on UIBs have not yet been done.

Methods

Nationally representative Demographic and Health Survey datasets from 27 LMICs across Africa and South-East Asia were appended. Weighted prevalence and 95% confidence intervals (CIs) were calculated while a Rao-Scott design-adjusted Chi-square test with second-order

correction estimated bivariate associations between predictors and UIBs. Multivariate logistic regression models were used to predict odds of UIBs across three blocks of predictor variables. The first block produced unadjusted odds ratios by treating country of residence as the only predictor. The second block added sociodemographic and sexual and reproductive health (SRH) variables, while the third added variables about the woman's partner, family power dynamics, and intimate partner violence. The regression analyses produced adjusted odds ratios (AORs), accompanying 95% CIs, and p-values for each predictor.

Results

The final sample (n=380,577) had an UIB prevalence of 19.4% (CI = 19.2 – 19.6). Model 3 showed the highest odds of UIBs among women from Lesotho (AOR = 11.13, CI = 8.54 – 14.51), as compared to all other countries; Africa (AOR = 2.62, CI = 2.09 – 3.29) as opposed to South-East Asia; and fragile regions (AOR = 1.44, CI = 1.30 – 1.59) compared to non-fragile regions. Also with the highest odds of UIBs were women aged 15-20 years (AOR = 1.65, CI = 1.40 – 1.94); women who were never married (AOR = 1.82, CI = 1.61 – 2.05), compared to those currently and formerly married; those with a primary education (AOR = 1.59, CI = 1.18 – 2.16); women with a parity of nine or more (AOR = 5.54, CI = 4.37 – 7.03), compared to women with parities of $\leq$2, 3-4, and 5-8; women who knew a modern method of family planning (FP) (AOR = 1.45, CI = 1.19 – 1.77) as opposed to those who did not; women whose partner completed secondary school (AOR = 1.36, CI = 1.20 – 1.55); women who have their healthcare decisions made by another family member (ref) as opposed to women that make their own healthcare choices (AOR = 0.91, CI = 0.83 – 0.99); and women who have ever had sex forced on them by a partner (AOR = 1.48, CI = 1.36 – 1.60) versus those who had not.

Conclusions

Although not statistically significant, relatively low odds of UIBs were observed in women with low SES, no education, without knowledge of modern contraceptives, and whose partners had no education. These findings may indicate that decreased levels of empowerment lead to a lack of FP or women feeling unable to classify births as unintended. Governments and donors associated with Lesotho, Malawi, Namibia, and South Africa are encouraged to increase efforts towards FP outreach and the prevention of UIBs. Stakeholders must pay special attention to UIBs in fragile settings and SSA since these regions had significantly higher odds of UIBs compared to non-fragile regions and South-East Asia, respectively. Women 20 years of age and younger; women not currently married; women married at age nine or younger; women with high parity; women who have their healthcare choices made for them by a family member; and women who had sex forced on them are at significantly higher risk of UIBs. Therefore, SRH practitioners are urged to focus FP programming on these subgroups of women when comprehensive and context-specific studies from which they can inform their practice are not available. Lastly, since several of the sociodemographic and SRH associations with UIBs observed in Model 2 lost statistical significance after adding partner and interpersonal covariates in Model 3, it is important for researchers and survey implementers to take indicators reflective of family dynamics into account in subsequent analyses on UIBs.

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1. Introduction

An unintended birth (UIB) results from a pregnancy that was either not wanted at all or wanted at a later point in time [1]. Unintended pregnancies (UIPs) are usually the direct result of the incorrect use, inconsistent use, or nonuse of modern methods of contraception [2,3]. In 2019, there were an estimated 121 million UIPs worldwide in women aged 15 – 49 years [4]. A global analysis in 2014 found that 44% of pregnancies and 23% of live births were unintended [5]. In addition to UIBs, UIPs can result in abortion, miscarriage, or stillbirth [6-8]. In 2012, roughly half of UIPs resulted in abortion, 13% resulted in miscarriage, and 38% in UIBs [7]. In 2014, 55% of UIPs in developing nations ended in abortion [5]. The hidden detail of these abortion statistics is that many are clandestine and/or unsafe, especially in countries where they are illegal, looked down upon because of religious or cultural norms, or access to high quality abortion services is poor. In countries where abortions were illegal or only allowed to save a woman's life, the proportion of UIPs ending in abortion was still 48% in 2014 [5], which indicates how common illegal abortion procedures are.

Even when UIPs result in a live birth, they still carry significant risks for both mother and child. UIBs result in higher rates of preterm babies [9,10], low birth weight (LBW) babies [9,10,12], and perinatal morbidity and mortality [9,12]. Another risk is vertically transmitted infections, such as HIV [13,14]. A study in South Africa found that HIV+ women who were not on antiretroviral therapy had higher odds of experiencing an UIP than HIV- women [13]. Women experiencing UIPs have demonstrated lower rates of accessing prenatal services [11,12,15,16], initiating routine care like childhood immunizations [3,10,17,18], breastfeeding [12], and were themselves prone to poor physical health [19,20], depression [19,20], and

substance abuse [11]. UIBs are associated with higher rates of physical and psychological mistreatment of the child by the father and mother, respectively [11].

The magnitude of the global prevalence of unintended pregnancies and births (UIP/Bs) and their associated negative sequelae necessitate the global health community working to reduce them. Between 1994 and 2014, the global rate of UIPs decreased from 74 to 62 per 1000 in women aged 15-44 years, representing a decline of 17% [5]. Unfortunately, this progress was not equitable between developing and developed nations. Between 1994 and 2014, the UIP rate fell by 30% in developed nations versus only 16% in developing nations [5]. In addition to the lagging progress in low- and middle-income countries (LMICs), the repercussions of UIPs are more severe in LMICs where health system infrastructure and the capacity to provide care to unexpected mothers and their babies are generally poor [21-23]. Regions with substandard availability of family planning (FP) and early-life services usually also limit or prohibit access to safe, legal abortions [6]. All of this results in a cycle that perpetuates high rates of UIPs followed by unsafe abortions or other unfavorable outcomes like miscarriages [6]. However, even when UIP/Bs result in a healthy birth, they can disrupt families, take away from a woman's ability to be in the workforce or further her education, perpetuate power differentials between men and women, increase a woman's chances of experiencing intimate partner violence (IPV), and put the child at risk both during the newborn stage and beyond. They are a drain on already stressed LMIC health systems and contribute to delayed progress toward better societal reproductive health, women's health, and early-life health for the offspring [5,21]. UIP/Bs have therefore been recognized as both a result and catalyst of social, economic, and gender inequality [21-23].

UIP/Bs can only be effectively prevented if the public health community comprehensively understands what factors predispose a woman to them. Unfortunately, the research base is still in

its infancy regarding this issue. A large number of studies have produced actionable data on UIP/B predictors that can be put into practice in very specific populations. However, they have limited generalizability because they are regional [12, 24-36] or single country-level [37-44] in focus, and often include only targeted subgroups of women [12, 25, 26, 32-34, 37, 38, 40, 41, 43, 44]. Further, most only consider a limited number of determinants in their predictive models either because of data unavailability or having a research question that limited the scope of the analysis. Only two studies were identified, one published in 2019 by Ameyaw et al. [45] and another in 2021 by Sarder et al. [46], that investigated predictors of UIBs on a multi-country scale. Sarder and associates pooled Demographic and Health Surveys (DHS) [47] from six South Asian countries [46], while Ameyaw et al. [45] pooled DHS data from 29 sub-Saharan Africa (SSA) countries. These works took an important first step in creating a research base on determinants of UIBs that is broad and generalizable, rather than regional and limited in scope. Multi-country studies that focus on a variety of subgroups of women and possible determinants of UIBs are necessary to clarify the broad sociodemographic, sexual and reproductive health (SRH), and interpersonal predictors of UIBs that can be addressed by governments, donors, practitioners, and other stakeholders.

Therefore, this project used DHS datasets to build on the multi-country research base that the two aforementioned studies [45,46] began. It pooled the most recent DHS data on 27 countries from Africa and South-East Asia and took into account novel sociodemographic, interpersonal, and family dynamic variables indicated to be important by regional studies that were not included in Ameyaw et al.'s [45] or Sarder et al.'s [46] analyses. Therefore, predictors of UIBs considered in this analysis were informed by those previous multi-country findings [45,46], the results from a literature review of regional studies, the availability of variables of

interest in DHS country datasets, and biological and epidemiological plausibility. DHS data is ideal for this research as it specializes in reproductive, maternal, newborn, and child health (RMNCH) in LMICs and is nationally representative, standardized across samples, and reproduced roughly every five years which makes longitudinal follow-up possible [48-53]. Since Ameyaw et al. [45] and Sarder et al. [46] used DHS data, this study's results are comparable to theirs. This could clarify associations they observed, unveil novel associations important to consider (e.g., fragility status of a country, health insurance coverage, household power dynamics, aspects of the woman's partner, etc.), and elucidate which determinants of UIBs are the most universal across African and South-East Asian populations. The goal is to produce a generalizable list of predictors of UIBs that can add to the conceptual understanding of sociodemographic and familial situations that typically lead to higher chances of UIBs. This can provide future research directions and also guide reproductive health programming in regions where comprehensive and context-specific studies on UIBs have not yet been done.

2. Literature Review

2.1 Overview

As part of the novelty of this project stems from the fact that it is multi-country in nature, it most directly built off the aforementioned SSA [45] and South-Asian [46] multi-country studies. However, years of smaller scale, regional, and more targeted studies laid the groundwork for what was done in those works. That research background was explored in this literature

review, which is divided into three sequential sections entitled: 'historical', 'current', and 'multi-country'.

In the 'historical' section, key findings and perspectives from studies that largely took place from the early 1980's until the mid-1990's were reviewed. This is not to indicate that research on UIP/Bs did not exist prior to 1980. However, while conducting this review, it was ascertained that most of the work that could realistically be seen to influence a research project of this kind began to burgeon in the early 1980's. Most studies in the 'historical' section were based in the United States.

The 'current' section contains information regarding how the topic is still being studied today and as it will be studied in this project. It details studies that mostly took part after the year 2000, have looked at UIP/Bs as a consequence of social determinants of health, and whose target sample resided in LMICs. There are several necessary subheadings in the 'current' section.

The 'multi-country' section describes findings from the multi-country studies [45,46] that most directly informed this analysis.

2.2 Historical

Much of the early literature on UIP/Bs was with respect to the prevention of adolescent pregnancies [54-59]. Other works investigated rape and abuse as causes of unwanted pregnancies [55,60,61]; or were interventional and focused on contraceptive use and sex education as methods of preventing unwanted pregnancies [62-69]. Most of these projects focused on teens as well. In addition to societal desires to limit adolescent childbearing, UIPs were also gaining

attention because researchers were beginning to make clear the negative repercussions of UIP/Bs. Various works in the 1980's and early 1990's indicated, in addition to abortions and their psychological consequences on families, that child maltreatment, vertical HIV/sexually transmitted infection (STI) transmission, LBW babies, preterm babies, and neonatal deaths were associated with UIP/Bs [62, 64, 65, 68, 70-73].

In her 1987 study of 518 urban, single parents receiving public assistance in the United States [62], Zuravin found that unplanned conceptions were not only due to nonuse of contraceptives, but also commonly their incorrect and inconsistent use as well [62]. This reiterated the need for not only expanding the provision of contraceptives, but also disseminating information about their proper use. She also found that unplanned conceptions increased the chances that the offspring would be abused and/or neglected [62]. Edelman in 1988 [58] indicated that adolescent pregnancies were in part a result of adolescents feeling they had no choices in life and, therefore, had nothing to lose by starting a family [58]. They were effectively disincentivized to prevent pregnancies because of not seeing any payoff from delaying them [58]. Edelman therefore suggested that schools could play a part in decreasing UIPs by increasing job and trade skill training for disadvantaged students to increase self-efficacy toward workplace opportunities, thereby providing them with a reason to delay pregnancies [58]. Jones et al. in 1988 [63] investigated a population with a larger age range and demonstrated that UIPs in women of all ages decrease when health systems serving them work to provide contraceptive information and to decrease structural barriers to obtaining contraception [63]. Jones et al. [63] and Westoff [64] spoke of how widespread contraceptive use could be an effective method of decreasing abortions, especially in Western societies where women were more likely to seek out abortions for unwanted pregnancies rather than carry them to term [63,64].

The early 1980's also produced important material on the consequences, including UIPs, of rape and abuse within marriages [74-76]. This was an especially controversial topic during the era of lawful marital rape exemptions [77]. Within a sample of women at domestic violence shelters in Michigan in 1989, Campbell and Alford [60] found that of the women who had been forcibly raped by their husbands, 20.4% reported a miscarriage or stillbirth and 17.4% reported an unwanted birth as a direct result of the rape event [60]. Similar studies [55, 74-77] were not only important steps in shining light on the problem of intramarital rape, but also for clarifying and bringing attention to the important link between sexual abuse and UIP/Bs.

As illustrated by the previous examples, most research in the 1980's focused on determinants of UIPs that were causal and, therefore, downstream in nature, like contraception nonuse and rape events. However, some studies in the early 1990's began to move the field forward by focusing on more upstream factors reflective of the social determinants of health. For example, Casper in 1990 [56] found that positive family interaction with an adolescent at crucial stages of their decision-making development could be effective in reducing adolescent pregnancy rates [56]. McCullough and Scherman in 1991 [59] also reinforced how varying types of social support were important in encouraging adolescent family planning [59]. In one of the larger studies (n=12,272) that had taken place up until this point, the US Centers for Disease Control and Prevention in 1991 [65] verified many of the findings from smaller studies [56, 58, 59, 62-64] when they outlined factors that simultaneously predispose adolescents to HIV infection and UIPs. These included incorrect and inconsistent use of condoms and other forms of contraception, having more than one sexual partner at a time, and initiating and engaging in sex at an early age, in particular prior to the age of 15 [65]. An intervention in 1992 by Barth et al. [54] sought to intervene with unwanted teen pregnancies by teaching adolescents reproductive

health and contraception knowledge and practices, and by communicating with their parents about pregnancy prevention. While the program had success with increasing the prevalence of respondents that used birth control, it did not affect post-intervention frequency of sexual intercourse or unplanned pregnancies [54]. This was important in confirming that while education and self-efficacy concerning reproductive health were important, there were other factors at play with unintended teen pregnancies.

Boyer et al. in 1992 [55] again highlighted the strong associations between adolescent sexual victimization, willingness to use contraception, and age at first sexual intercourse with future UIBs and mistreatment of the subsequent offspring. In 1994, Bustan and Coker [73] did a novel study where they linked a woman's negative attitude toward her pregnancy (i.e., did not want the child, wanted the child later) with an increased risk of neonatal death [73]. Also in 1994, Forrest [66] conducted a country-wide study in the United States on UIPs and showed that not only adolescents, but also formerly married women and women of low SES demonstrated higher odds of not using contraception and reporting contraceptive failure, which led to higher rates of UIPs in these subgroups [66]. This study was valuable not only because it was large scale and confirmed findings from regional studies, but it also showed the necessity of considering other sociodemographic subgroups beyond adolescents in analyses of UIP risk [66]. In 1994, Herold et al. [67]observed that for a group of 15-25 year old women in Santiago, Chile, having less sex education prior to first sexual intercourse, moral ambivalence about premarital sex, and being Catholic increased the likelihood of UIPs [67]. Along with the expansion of predictors of UIPs considered, the mid-1990's saw an increase in the study of the negative psychological and social outcomes associated with UIP/Bs. These included lower earning

potential and long-term psychological morbidity for the mother, increased costs for health systems, and suboptimal child development [57, 61, 68, 69, 72].

2.3 Current

2.3.1 Orientation

Over the past 20 years, a greater recognition that UIP/Bs are important issues for all women, not just adolescents, has been reflected in a larger research output regarding UIP/Bs in a variety of ages, social subgroups, and locales. Also, the realization that social determinants of health and other upstream factors (i.e., issues beyond proximal causes like contraception nonuse and rape) likely play a significant role in UIP/Bs has become commonplace. Of particular importance is that a wider range of studies investigating determinants of UIP/Bs in LMICs is now available.

A review of the contemporary literature is provided in this section and delineated as follows. First, key findings from regional (local and country-level) studies are presented according to the WHO region in which they took place. The 'South-East Asian' and 'African' regions were explored since these are the regions covered in this study and in the previous multi-country studies [45,46]. Finally, a 'summary/synthesis' section presents findings broken down by key independent variables irrespective of which of the aforementioned regions the original studies came from. In some cases, findings from regions other than SSA and South-East Asia may be included in the 'summary/synthesis' section if particularly relevant.

Projects were mostly secondary, cross-sectional analyses that used DHS datasets and therefore classified UIBs according to DHS criterion [37-44]. One secondary analysis used an

African Population and Health Research Centre dataset [30]. Primary analyses were done with the systematic sampling of recent mothers and by using questionnaires modeled after the DHS [26] and the London Measure of Unplanned Pregnancy [28,29], while others created their own surveys [12, 24, 25, 27, 31-36]. Three studies were case-controls [25,31,39]. A variety of statistical analyses were used including multivariate logistic regression to produce adjusted odds ratios (AORs) with reported birth intention separated into a binary outcome variable [12, 24-28, 30-38, 40, 41, 43, 44], conditional logistic regression [39], logistic regression with crude odds ratios (ORs) [31], multilevel logistic regression to account for clustering [42], and multiple linear regression informed by a conceptual hierarchical model [29]. Some studies also differentiated between mistimed and unwanted pregnancies as outcome variables [12,39,40,44].

Studies either sampled women aged 15-49 years who had given birth within the last 3-5 years of the survey being carried out, as this is standard DHS protocol for ascertaining pregnancy intention; or sampled currently pregnant women or women who had recently given birth, irrespective of age. Many studies however only investigated specific subgroups such as ever-married women [12, 25, 26, 32, 40, 44], ever-married rural women [41], currently pregnant and married women [20,38], married 15-25 year old women [37], HIV-infected women [33], and women attending STI clinics [34].

Most common explanatory variables included in the study models were age [12, 24, 27, 31, 33, 36, 39, 42, 44, 78], education level [12, 25-30, 32, 33, 36, 37, 39-42, 79], literacy [28, 38, 39, 43], marital status [24, 30, 31, 33, 34, 36, 42], husband's education [12, 35, 37, 39], husband's literacy [39, 43], husband's age [12, 29], woman's age at first marriage [25, 28, 38, 40, 41, 43], parity/gravidity [24-26, 28, 30, 33, 36, 40, 44], religion (Christianity [36, 44], Islam [36, 39, 41, 43, 44], Hindu [38, 39]), SES [12, 28-31, 33, 36, 37, 39-41, 43, 44], employment/occupation [12,

24-26, 30-33, 36-38, 40, 44], occupation of partner [12, 31], aspects of contraception knowledge or use [26, 28, 33, 35-44], urban/rural status [12, 24, 28, 31, 35-40, 42-44], intimate partner violence [29, 34, 37, 44], previous child loss [32, 39], and previous terminated pregnancy [27, 28, 32, 44].

2.3.2 South-East Asia

A study using DHS data in Bangladesh in 2004 found that 10,544 ever-married Bangladeshi women between the ages of 10-49 who were low- and middle-income (LMI) exhibited higher odds of having a mistimed pregnancy compared to high-income women [40]. In addition, women with a secondary education had higher odds of unwanted and mistimed births than women with no education [40], which contradicts most other studies that found the largest association with UIBs among those with no education. Another study [41] on 10,996 ever-married rural Bangladeshi women using 2007 DHS data found that Islamic women as opposed to non-Islamic women, and women who had four or more previous births as opposed to women with three or less, demonstrated higher odds of having an UIB [41]. Contrary to findings from most other studies, this study [41] found that women between the ages of 20-29 years had a higher probability of unplanned births than women between the ages of 15-19 [41]. Rahman [43] interviewed 718 currently pregnant women in Bangladesh that were extracted from the 2007 DHS and showed that urban women, Muslim women, and women with no media access had higher odds of UIBs [43]. With 2001 DHS data collected from 751 married, currently pregnant women in Nepal, Adhikari et al. [38] found that Hindu women and women with radio access had significantly lower odds of UIBs than non-Hindus and women with no radio access, respectively. Their other findings generally are reflective of other Southeast Asian findings [40,41,43]. Results from analyses using 2016 DHS data collected among 560 15-24 year old married women living

in Nepal showed that women who had ever suffered sexual violence from their partner had significantly higher odds of experiencing an UIB than those who had no experience with sexual violence [37]. A secondary analysis in India using the 2006 National Family Health Survey found that women (n=36,832) who were of the poorest wealth quintile and illiterate had higher odds of UIBs [39]. They were also more likely to report their previous birth as unintended if the child was female [39]. Lastly, women who had ever used contraception versus those who never used contraception had higher odds of reporting an UIB [39].

2.3.3 Africa

In a survey with a case-referent design [31] conducted in Harare, Zimbabwe in 1997 among 923 recent mothers, higher odds of UIBs were observed among women under 19 or over 35 years, were nulliparous or who had more than five previous pregnancies, were unemployed, single, and/or low-income [31]. There was no association between level of education and odds of UIB [31]. Despite the fact that this study was limited with respect to sample size and geographic scope, it was one of the earliest studies that looked at a larger variety of sociodemographic factors as potential predictors of UIBs in an African country [31]. An analysis with 1993 Kenya DHS data [42] on 5914 births revealed a significant association between level of education and UIBs, although it was not monotonic since women with a primary education showed the highest odds of having mistimed and unwanted births, whereas women with no education and secondary or above education had the lowest [42]. Magadi [42] observed that women living in rural areas, single women, and those who have given birth to more than five children showed higher chances of having an UIB [42]. Magadi [42] differentiated between mistimed and unwanted births, and found that women over the age of 35 had lower levels of mistimed births, but higher levels of unwanted births; while women under the age of 20 had higher odds of reporting mistimed births,

but lower odds of unwanted births compared to women aged 35 years or older [42]. Another report from Kenya [30] with data collected from 1272 women in 2009 by the African Population and Health Research Centre revealed that women living in non-slum settlements were more likely to experience UIPs than women living in slum settlements [30]. Women aged 35-49 years had lower odds of UIPs than women aged 15-19 years [30], which is in contrast to other studies that in general found that women under the age of 20 and women over 35 had similar rates of UIPs when the differentiation between mistimed and unwanted pregnancies was not made. Hall et al. in 2016 [29] studied 4244 pregnant women in Mchinji, Malawi and used a conceptual hierarchical model to show that lower SES was associated with greater probability of having an UIP, but that its effect in part was mediated by sociodemographic factors like marital status, age of the woman's partner, and the woman's education level. This study was limited in geographic scope but novel since it found that in addition to young age, depression and abuse were associated with UIPs [29].

In a large Nigerian survey by Yaya et al. [44] that pooled 2003, 2008, and 2013 DHS data resulting in a sample size of 79,825 married women, researchers found that women with higher education had higher odds of UIBs as opposed to those with no education. Also, they found that women with a higher wealth index were more likely to have UIBs than were lower wealth index women [44]. Lastly, Yaya et al. [44] demonstrated that women with a past terminated pregnancy were more likely to have an UIB in the future than were women with no history of terminated pregnancy.

In a survey [24] interviewing 674 women in Northwestern, Ethiopia in 2018, women living away from their husbands and women with no media exposure in the home had significantly higher odds of UIP [24]. There were no significant associations between age,

urban/rural status, occupation, education, or marital status with UIPs [24]. A 2019 study of 398 women from Northwestern Ethiopia [36] found that women who were rural residents, and Orthodox Christians as opposed to Muslims, had higher odds of UIBs [36]. Women with secondary educations had the lowest odds of UIBs [36]. In one of the few investigations that analyzed aspects of the husband exclusively as predictors of UIBs in Southern Ethiopia, Seifu et al. [35] examined 627 married women and found that those who had husbands with university-level education showed significantly lower odds of experiencing an UIB compared to those whose husbands had no education. However, the university group was not statistically different from women whose husbands had primary or secondary education [35].

2.3.4 Summary/Synthesis of Variables

2.3.4.1 Age

Many of the regional and country-level studies found that a woman's age is a strong predictor of UIBs. Some of these studies found that older women (roughly 30 years and up) had higher odds of reporting UIBs than younger women (roughly $\leq$ 20 years). Two such studies took place in Egypt [12,80], two were in Bangladesh [40,41], two were in Nigeria [81,82], and one was in Vietnam [83]. More commonly however, studies showed that younger women had higher odds of experiencing UIBs. Some examples include studies that took place in Nigeria [44], the United States [84], Spain [27], Ethiopia [85], Senegal [86], Kenya [30], Spain [27], and Pakistan [28]. In several investigations age had no effect on odds of reporting births as unintended [24, 25, 33, 36, 87]. Discrepancies in the literature about the effect of age on UIBs seem in part to be due to the difference between mistimed and unwanted pregnancies. Women under the age of twenty, if given the opportunity to make the distinction between a mistimed and unwanted pregnancy, are more prone to saying a pregnancy was mistimed due to their presumed

acknowledgement that at some point they would like to have a child [42]. Older women, generally over 30 or 35 years, are more willing to classify a child as unwanted, due to having the child at a point in their life when they were sure they did not want any more [42]. It is plausible that this effect was at play when several studies [31, 42, 43, 81, 83] that did not distinguish between mistimed and unwanted pregnancies found that women under 20 and over 35 had roughly equivalent odds of having UIPs.

2.3.4.2 Education level

Results regarding the effect of education on odds of UIBs were highly mixed. Many studies showed that women with no education had the highest odds of UIB [27, 29, 39, 85]. Some surveys however contradicted this by demonstrating that higher education women had higher odds of UIB [37, 40, 44, 81, 87, 88]. There were also several studies that showed no association between level of education and UIB [24-26, 30, 31, 33, 38, 82, 89]. Results from investigations in Uganda [90], Kenya [42], Ethiopia [36], and Pakistan [28] showed statistically significant associations between education and UIB, however they were non-monotonic.

2.3.4.3 SES

Most studies indicate that lower SES predisposes a woman to higher odds of UIB [12, 31, 39, 41, 91-93]. This was not always the case however as some studies presented exactly the opposite findings [44, 94], no association [30, 33, 36], or significant but non-monotonic results [28, 40, 43].

2.3.4.4 Parity

Generally, odds of future UIBs were seen to increase as the past parity of the woman increased [12, 25, 28, 33, 38, 40, 42, 44, 95]. The association with parity and UIB was

sometimes in a sense bimodal, with nulliparous women and women who had roughly five or more pregnancies having the highest odds of UIBs, while women with roughly two to four births had lower odds [31].

2.3.4.5 Age at first marriage

Most studies that included age at first marriage in their models found that the older a woman was when she first got married, the less odds she had of reporting an UIB later [38, 40, 96, 97]. One investigation found no association between age at first marriage and UIB [25].

2.3.4.6 Religion

Results concerning the effect of religious membership on UIBs were mixed or simply incomplete because they only compared one religion to all others (i.e., Muslim versus non-Muslim), rather than comparing many religions (i.e., Muslim, Christian, Hindu, etc.) in the same analysis. Of course, this is to be expected in regional studies where generally one religion would predominate. Some studies showed that Muslims had higher odds of UIBs [39, 41, 43, 90, 98], while others showed Christians did [44, 85, 94]. One specifically showed that Orthodox Christians had higher odds of UIBs as opposed to Muslims [36]. Another showed that Hindus compared to all non-Hindus had lower odds of UIBs [38].

2.3.4.7 Marital status

The majority of studies that investigated this variable showed that married women had lower odds of UIBs compared to single women [27, 29-31, 33, 42, 44, 85, 94, 98]. A study in Ethiopia showed no significant association between marital status and UIB [24]. Another showed that married women were more likely to experience UIBs, however this was only among women attending an STI clinic [34].

2.3.4.8 Previous negative pregnancy outcomes

Several investigations reported that women who previously had an abortion demonstrated higher odds of having a future UIB [99-101]. A study in 2016 in Ethiopia [102] found that previous stillbirths were associated with increased future odds of UIB. In Nigeria, history of terminated pregnancy was associated with future UIBs as well [44]. In a study in Pakistan, previous abortions and miscarriages were not associated with future odds of UIBs [28].

2.3.4.9 Contraception

Contraception use is not a focal point of this analysis since it is a downstream determinant of UIP/Bs. Moreover, the research base regarding contraception use and knowledge is well-established with respect to their role in preventing UIP/Bs. However, for the sake of completion, a few basic findings from regional studies that included contraceptive use and knowledge in their models are described here.

Women with knowledge of family planning have lower odds of UIPs [28,38]. In general, women who reported ever having used a modern method of contraception or were using modern contraception at the time of their last conception had higher odds of reporting that pregnancy to be unwanted [34,35, 39-44]. At first glance this finding may seem paradoxical, but if a woman is consciously using contraception it would effectively mean any pregnancy would be unintended. Some surveys found no association between use/ever use of contraceptives and UIP [33, 36-38].

2.3.4.10 Urban/Rural Status

There were discrepancies about whether urban or rural women were more likely to have UIBs. In some studies rural women were [28, 36, 38, 40, 42, 90], in others urban women were [39,43]. Some found no association between urban/rural status and odds of UIB [44, 80, 85].

2.3.4.11 Employment/Occupation

Unemployed women had higher odds of UIBs in studies in Zimbabwe, Nigeria, and Iran [25, 31, 44]. On the other hand, employment had no significant association in other studies [26, 30, 33, 36]. Employment and occupation variables were limited with respect to generalizability much in the same way that religion was. In most studies, only a small list of occupations was analyzed due presumably to limitations in data availability. Some studies only investigated employment versus non-employment and, therefore, did not yield any data on types of professions that may predispose a woman to higher odds of UIBs.

2.3.4.12 Aspects related to partner

There is limited data on this class of variables as most studies did not account for characteristics of the husband/partner. One survey found that women whose partner had no income had higher odds of UIBs [31]. Women experiencing domestic violence in Nigeria demonstrated higher odds of UIBs [44]. Women whose husbands had a university education as opposed to no education had lower odds of UIBs [35]. Having a younger husband was associated with higher odds of UIB in a study in Egypt [12].

2.4 Multi-Country

The literature review revealed only two studies that conducted multi-country, pooled analyses of nationally representative data that included all women of reproductive age and marital statuses [45,46]. One that was published in 2019 by Ameyaw et al. [45] used DHS

surveys to pool data from 29 SSA countries. The other was published in 2021 by Sarder et al. [46] and used DHS surveys to pool data from six South-Asian countries [46].

In a finding contradictory to most of the regional-level studies, Ameyaw et al.'s [45] SSA study found 15–19 year old women to have lower odds of UIBs compared to all other age groups (20-24, 25-29, 30-34, 35-39, 40-44, and 45-49 year old women) [45]. In a finding consistent with previous studies, women between the ages of 30-39 years had high odds of UIBs [45]. Ameyaw et al. [45] also found that married/cohabitating, widowed, and divorced women all had significantly higher odds of UIBs compared to single women, which is another contradictory finding to many of the regional studies [45]. There was no statistical difference between urban and rural women [45]. Women with no education had the highest odds of UIBs compared to primary school, secondary school, and higher, which is consistent with most findings [45]. Women from the poorest wealth index quintile had higher odds of UIBs compared to the poorer, middle, richer, and richest groups [45]. Women with zero previous births were more likely to have a future UIB, whereas women with the highest parity analyzed ($\geq$4 previous births) had the lowest odds of a subsequent UIB [45]. Islamic women had higher odds of UIBs compared to Christian women [45], but the difference in odds between Islamic women and women of "traditionalist" religions or no reported religious affiliation was not statistically significant. Lastly, women who knew of a modern method of contraception had the lowest odds of UIB compared to women who only knew of a traditional method or no method at all [45].

Sarder et al.'s study [46] in South Asia found that 15-19 and 40-49 year old women had the highest odds of UIBs, which is reflective of some regional studies that showed "younger" and "older" women had the highest odds of UIBs [46]. However, Sarder et al. [46] found that women of all age groups between 20 and 39 years had the lowest odds of UIBs, whereas regional studies

started to find that once women were over 30, their odds of UIBs started to increase. Rural women had higher odds of UIBs than urban women and education level had no association [46]. Women from the 'poorest' and 'poorer' wealth quintiles had the highest odds of UIB compared to the highest three wealth quintiles [46]. Islam and Hindu religions had the highest odds of UIBs compared to all others [46]. Women with a parity of zero had the lowest odds of UIBs compared to women with higher parity, in particular those with over three previous children [46]. Lastly, women who first married/cohabitated prior to turning 20 years of age had lower odds of UIBs compared to those who first cohabitated after they turned 20 years [46]. This finding contradicts most regional studies.

2.5 Lead-in to Methods Section

2.5.1 Conclusion of literature review

The findings presented from regional studies were highly variable and mixed from region to region and country to country, and cutoff points used for categorical variables were inconsistent across studies. Multi-country analyses like Ameyaw et al. [45] and Sarder et al. [46] are a logical first step in better elucidating determinants of UIBs that are more constant and generalizable throughout understudied LMIC regions. This study built from these two studies by including more countries in an analysis that spanned two WHO regions. Also included were other variables that the literature review of regional studies indicated were important but were not included in either one or both of the aforementioned multi-country studies [45,46].

2.5.2 Summary of Main Objectives

(i) Determine the prevalence of UIBs across all countries and sociodemographic subgroups included in the analysis;

(ii) Identify which associations between predictors and UIBs uncovered in the previous multi-country studies change, or remain consistent, after including more countries, new variables, and more accurate subgroup categories;

(iii) Determine if, and by how much, the new variables are associated with UIBs; and

(iv) Produce a generalizable and comprehensive list of variables that are predictive of higher odds of UIBs across different countries and WHO regions; which can serve as a framework to guide future analyses and policy recommendations.

3. Methods

3.1 Data Source

The Standard DHS women's survey [103] was used for this project, which interviews women 15-49 years of age in LMICs primarily on RMNCH topics [48,49]. They are conducted using a two-stage sampling design. In the first stage a sample frame consisting of primary sampling units (PSUs) from a population census is selected according to its population and stratification characteristics [48,49]. In the next stage field teams go to selected PSUs and create a listing of households from which systematic sampling is employed to select approximately 30

for in-depth interviews [48]. Trained interviewers from country-specific agencies then go to the households to identify eligible women for interviews, who are then interviewed after providing consent. DHS surveys use well established questionnaires and usually have response rates over 90% [48,49]. Surveys are implemented via a collaboration between ICF International [103], the United States Agency for International Development, and country-level partners like National Statistics Offices and/or Ministries of Health. Between 1984, when DHS began, and 2010, DHS datasets produced 1117 peer-reviewed publications appearing in over 200 journals [52]. Advantages of DHS are the high response rates, quality interviewer training, national representativeness, use of complex sampling to ensure representation of hard-to-reach populations, and the fact that the core DHS questionnaire has been standardized to maximize comparability and reproducibility [48,50,51,53]. DHS surveys have been used successfully in other recently published, multi-country studies on similar topics using analogous methodologies to the ones proposed for this project [45,46, 104-106]. The final dataset was produced by using the Integrated Public Use Microdata Series (IPUMS) [107,108] DHS data management tool. The IPUMS service allows one to append DHS data from several countries accurately by harmonizing variables across datasets in a web-based portal. This maximizes the final appended dataset's standardization and comparability across variables, countries, and DHS versions.

The analysis includes 27 LMICs from the African and South-East Asian WHO regions. The included countries and years that the DHS was carried out in them are: Angola (2015), Burundi (2016), Cameroon (2011), Democratic Republic of Congo (2013), Ethiopia (2016), Ghana (2014), Guinea (2018), Cote d'Ivoire (2011), Kenya (2014), Lesotho (2014), Liberia (2013), Malawi (2016), Mali (2018), Mozambique (2011), Namibia (2013), Niger (2012), Nigeria (2018), Rwanda (2014), Senegal (2017), South Africa (2016), Zimbabwe (2015),

Uganda (2016), Tanzania (2015), Zambia (2018), Myanmar (2015), India (2015), and Nepal (2016). The most recent survey for each country was used. Countries whose most recent surveys were conducted earlier than 2011 were excluded. Countries were included that had all variables of interest. DHS granted permission to use these datasets for the purposes of this analysis and the Claremont Graduate University Institutional Review Board (IRB) approved the study.

3.2 Dependent Variable

The dependent variable is whether the woman's last birth was intended or not intended. If a woman's most recent birth was within 5 years of the survey, she was asked: "When you got pregnant with (NAME), did you want to get pregnant at that time?" If she responded "no", she was then asked: "Did you want to have a baby later on, or did you not want any(more) children?" The responses to these questions were captured in the DHS variable entitled 'FPLCHDESIRE' as three possible responses: 1) "Wanted last child then", 2) "Wanted last child later", and 3) "Wanted no more children". Responses of "wanted last child later" and "wanted no more children" were recoded as '1', meaning these were UIBs. "Wanted last child then" was recoded as '0', meaning it was an intended birth. This methodology was used to classify pregnancy intention in the aforementioned multi-country studies [45,46] and several regional studies [37-44].

3.3 Independent Variables

Based on biological and epidemiological plausibility as determined from the literature review, the availability of variables, and desired novel analyses, 27 independent variables were

analyzed. They include country of residence, WHO region (Africa, South-East Asia), fragility status (non-fragile, fragile), the respondent's age (15-20, 21-30, 31-40, 41-49 years), type of residence (urban, rural), health insurance coverage (yes, no), current marital status (never married, currently married, or formerly married), highest education level achieved by respondent (none, primary, secondary, higher), wealth index quintile (poorest, poorer, middle, richer, richest), occupation (not working, professional/clerical, agricultural, manual/household labor, armed forces), religion (Muslim, Catholic Christian, Orthodox Christian, Protestant Christian, Other Christian, Buddhist, Hindu, Sikh, Other, no religion), age when respondent first had sex ($\leq$11, 12-15, 16-19, 20-29, $\geq$30 years), lifetime number of sexual partners (one, 2-5, 6-10, $\geq$11), age when first married ($\leq$9, 10-15, 16-20, 21-30, $\geq$31 years), duration of current marriage ($\leq$9, 10-19, $\geq$20 years), number of unions (one, $\geq$2), respondent's parity ($\leq$2, 3-4, 5-8, $\geq$9), history of pregnancy termination (yes, no), FP awareness (respondent knows a modern method of FP, respondent does not know a modern method of FP), respondent knows a source of FP (yes, no), and does the respondent have knowledge of emergency contraception (yes, no). Variables about the woman's partner were included as well, such as the partner's age at reference birth (10-15, 16-20, 21-30, 31-40, 41-50, $\geq$51 years), the partner's highest education level achieved (none, primary, secondary, higher), and the partner's occupation (not working, professional/clerical, agricultural, manual/household labor, armed forces). Lastly, variables reflective of empowerment and VAW were included, such as whether or not the respondent makes her own health care choices (yes, or another family member decides for her), whether the respondent believes that her being beaten is justified if she refuses sex (yes, no), and whether or not a partner has ever forced sex on her (yes, no).

Fragility status was included in the analysis since reproductive and maternal health has repeatedly been shown to be extremely poor in fragile and conflict-affected situations (FCS) where governance is poor or nonexistent, the environment is highly stressful, families may be separated, health infrastructure breaks down, and people may have to go through periods living in refugee or internally displaced people settlements [109-115]. Rape and violence against women may also accompany war, although this is not always observed to be the case [112-115]. For the purposes of this analysis, a country was denoted as fragile if it had appeared on the World Bank Group's (WBG) annual FCS list [116] within two years of the DHS survey being carried out in that country. The WBG bases fragility and conflict statuses on metrics like Country Policy and Institutional Assessment scores [117], presence of United Nations peacekeepers, number of refugees produced, and deaths resulting from conflict as calculated by the Armed Conflict Location and Event Data Project [118] and the Uppsala Conflict Data Program [119].

DHS calculates wealth index by principal component analysis (PCA) which places households on a continuous scale of relative wealth according to assets [49]. The household's wealth index is a composite measure of its cumulative living standard. The DHS household questionnaire has data on the possession of consumer items and dwelling characteristics like televisions, cars, flooring material, drinking water source, and type of toilet facility used. Each of these assets is then assigned a factor score generated through the PCA. Scores vary depending on whether or not an asset is owned, or by what type of facility (i.e., improved versus unimproved sanitation, or dirt versus carpeted floor) the household makes use of. Asset scores are then standardized in relation to a standard normal distribution (i.e., mean of zero and standard deviation of one) and used to create cutoff points to define five groups of wealth quintiles with equal numbers of individuals from the population in each [49].

3.4 Data Manipulation and Analysis

Individual datasets from the 27 countries were appended. Women who did not give birth in the five years leading up to the survey, and therefore had no data concerning pregnancy intention were excluded, which gave an initial sample of 380,744. Missing responses (n=197) to the pregnancy intention question were excluded to yield the final valid sample of 380,577. Age and other continuous variables were recoded into categorical variables according to the cutoffs outlined in the 'Independent Variables' section. Descriptive analysis crosstabulations were conducted to yield weighted prevalence of UIBs with 95% confidence intervals (CIs) for each variable subcategory. The design-adjusted CIs capture information on statistical significance of differences and precision of prevalence across variable subcategories. A Rao-Scott design-adjusted Chi-square test with second-order correction was employed for hypothesis testing on bivariate associations between variables and UIBs.

Next, three logistic regression models were conducted in which unintended/intended birth was the binary outcome. Variables that had statistically insignificant associations ($p \geq 0.05$) in the Chi-square bivariate tests of independence were not entered into the logistic regression models. In Model 1, crude odds ratios (ORs) were calculated via bivariate logistic regression to produce baseline odds of UIBs for each country, without controlling for other independent variables. Design-adjusted 95% CIs were produced for Model 1 along with the overall p-value. In Model 2, variables capturing sociodemographic and SRH characteristics of the respondents were entered into a multivariate logistic regression to produce adjusted odds ratios (AORs), accompanying 95% CIs, and p-values. This general statistical methodology was informed by previous regional studies [12, 30, 33, 34, 36, 44, 86, 88, 90, 94, 98, 100] and the two multi-country studies [45,46]. However, Ameyaw et al. [45] and Sarder et al. [46] produced crude ORs based on country, and

then did one multivariate analysis where sociodemographic variables were added for their final model. Therefore, Model 2 in our analysis is reflective of the two multi-country studies' [45,46] final model. This project however added a third model which added variables about the woman's partner, whether she makes her own healthcare decisions or not, and her attitudes toward intimate partner violence (IPV) and past experiences with IPV. The reference category was intended births, meaning that a crude OR or AOR greater than one (1) indicates greater odds of the sub-group in question experiencing an UIB, whereas ORs less than one (1) indicate lower odds. Independent variables' associations with UIBs were considered statistically significant at the 95% level of significance (i.e., $p<0.05$). Primary sampling units, sample strata, and sample weights were accounted for in all analyses by applying sample weights and adjusting for the DHS cluster sampling techniques using the SPSS Version 26 Complex Samples Package [120] according to instructions in the Guide to DHS Statistics, DHS-7, Version 2 [49]. All data management, manipulation, and analyses were carried out using IBM SPSS Version 26 [120].

4. Results

Table 1 presents a basic breakdown of the sample by giving frequencies and percentages of each geographic variable's contribution to the sample. Frequencies and prevalence of UIBs across countries, WHO regions, and in fragile versus non-fragile regions are provided as well, along with bivariate analyses of their association with UIBs. The pooled sample was composed of 24 countries from the SSA WHO region and three countries from the South-East Asian WHO region. The final sample size was 380,577 with an overall UIB prevalence of 19.4% (CI = 19.2 –

19.6). The African region provided 181,907 cases (48.5%) to the total sample, while South-East Asia contributed 198,670 cases (51.5%). Fragile regions provided 101,596 cases (27.0%) and non-fragile regions contributed 278,981 cases (73.0%). The prevalence of UIBs ranged from 8.8% in Niger to 55.0% in South Africa. Prevalence of UIBs was 29.9% in Africa and 9.4% in South-East Asia. Fragile regions had an UIB prevalence of 27.0% while in non-fragile regions it was 16.5%. Country, WHO region, and fragility status all had statistically significant bivariate associations with UIBs ($p<0.001$).

Table 1: Prevalence of unintended births and bivariate analyses across geographic variables

Variables	Sample size and percent of total	Unintended Births	Bivariate Significance
	n (column %)	n (row %, 95% CI)	χ2 (p-value)
Country (year of DHS)			697.4 (<0.001)
All Countries	380577	72314 (19.4, 19.2 – 19.6)	
African Region			
Angola (2015)	8947 (2.3)	3098 (37.4, 35.2 – 39.6)	
Burundi (2016)	8660 (2.4)	2969 (33.8, 32.6 – 35.0)	
Cameroon (2011)	7631 (2.0)	2129 (26.8, 25.4 – 28.2)	
Democratic Rep. of Congo (2013)	11281 (3.0)	3417 (32.3, 30.1 – 34.6)	
Ethiopia (2016)	7193 (2.0)	1452 (26.6, 24.7 – 28.5)	
Ghana (2014)	4294 (1.1)	1270 (32.9, 30.5 – 35.4)	
Guinea (2018)	5530 (1.5)	934 (16.7, 15.4 – 18.1)	
Cote d'Ivoire (2011)	5418 (1.4)	1443 (26.8, 25.0 – 28.7)	
Kenya (2014)	7167 (1.8)	2668 (40.1, 38.5 – 41.7)	
Lesotho (2014)	2596 (0.7)	1378 (53.5, 51.2 – 55.7)	
Liberia (2013)	5345 (1.3)	1845 (32.6, 30.1 – 35.3)	
Malawi (2016)	13448 (3.6)	5830 (43.4, 42.2 – 44.5)	
Mali (2018)	6368 (1.8)	935 (15.9, 14.5 – 17.5)	
Mozambique (2011)	7623 (2.1)	1505 (16.4, 15.3 – 17.5)	
Namibia (2013)	3967 (1.0)	2102 (53.0, 51.0 – 54.9)	
Niger (2012)	7672 (2.1)	691 (8.8, 8.0 – 9.7)	
Nigeria (2018)	21792 (5.9)	2738 (12.1, 11.5 – 12.9)	
Rwanda (2014)	5953 (1.6)	2362 (39.4, 38.1 – 40.8)	
Senegal (2017)	8468 (2.1)	1648 (21.0, 19.7 – 22.2)	
South Africa (2016)	3036 (0.8)	1720 (55.0, 52.4 – 57.5)	
Zimbabwe (2015)	4833 (1.3)	1734 (35.1, 33.5 – 36.7)	
Uganda (2016)	10263 (2.7)	4571 (44.8, 43.5 – 46.2)	
Tanzania (2015)	7050 (1.9)	2357 (34.0, 32.3 – 35.7)	
Zambia (2018)	7372 (2.0)	2953 (40.7, 39.0 – 42.4)	
South-East Asian Region			
Myanmar (2015)	3867 (1.0)	355 (9.1, 7.9 – 10.4)	
India (2015)	190797 (49.4)	17390 (9.2, 9.0 – 9.4)	
Nepal (2016)	4006 (1.1)	820 (20.0, 18.3 – 21.8)	
WHO Region			9655.1 (<0.001)
African	181907 (48.5)	53749 (29.9, 29.6 – 30.3)	
South-East Asian	198670 (51.5)	18565 (9.4, 9.2 – 9.6)	
Fragility			1771.8 (<0.001)
Non-Fragile	278981 (73.0)	45001 (16.5, 16.3 – 16.8)	
Fragile	101596 (27.0)	27313 (27.0, 26.5 – 27.5)	

Notes: Frequencies are raw counts, whereas percentages and 95% confidence intervals are weighted. Bivariate significance is based on the second-order Rao-Scott adjusted chi-square statistic.

Table 2 shows frequencies and percentages of UIBs across sociodemographic and SRH variables. The highest prevalence of UIBs were observed among women who had the reference birth between the ages of 41-49 years (32.3%), which was followed by 15-20 year olds (25.0%) and 31-40 year olds (22.2%). The lowest prevalence of UIBs was seen in the 21-30 year age category (16.3%). Urban women had an UIB rate of 20.5%, whereas in rural women it was

18.9%. Respondents without health insurance had an UIB prevalence of 19.4%, while those with health insurance had a prevalence of 13.3%. The percentage of UIBs in women who were never married was 63.4%, followed by formerly married women (35.7%) and currently married women (16.7%). Women with a 'higher' level of education had the lowest rate of UIBs (11.0%) while those with a primary education had the highest (28.0%). Women belonging to the 'richest' wealth index quintile had the lowest prevalence of UIBs (17.8%, CI = 17.3 – 18.3). The highest percentage of UIBs was among women in the 'poorer' quintile (19.6%, CI = 19.2 – 20.0), although their 95% CI overlapped with those in the 'poorest' (19.3%, CI = 18.9 – 19.7) and 'middle' (19.2%, CI = 18.8 – 19.7) wealth index quintiles. With respect to occupation, the lowest percentage of reported UIBs were observed among women who were not employed (23.1%), while the highest were observed among women in the armed forces (45.1%). Women who identified as being a member of the Sikh faith had the lowest percentage of UIBs (6.2%), whereas women who were Protestant Christians had the highest (36.9%). Women with no religious affiliation had a rate of 27.7%.

UIB prevalence was the highest among those who first engaged in sexual intercourse at 11 years of age and under (24.1%, CI = 22.4 – 25.9) and between the ages of 12 and 15 (24.1%, CI = 23.7 – 24.5). The lowest UIB percentage was observed in those who first engaged in sexual intercourse at 30 years of age or later (8.4%). Women who only had one sexual partner in their lifetime had a lower prevalence of UIBs (21.6%) than women with two to five partners (34.7%), six to ten partners (35.8%), and 11 or more lifetime partners (27.6%). Women who were married at nine years of age or younger had the lowest prevalence of UIBs (14.0%, CI = 11.4 – 17.1), but this overlapped with the CI observed among those who first married between the ages of 21-30 (15.5%, 95% CI = 15.2 – 15.9) and 31 years and over (16.5%, CI = 15.0 – 18.1). The highest

prevalence of UIB was observed in those who were first married between the ages of 10 to 15 (18.5%, CI = 18.1 – 18.9) and 16 to 20 (18.3%, CI = 18.0 – 18.6). Women who were married for nine years or less had the lowest prevalence of UIBs (14.7%), compared to those married for 20 years or more, who had the highest (30.2%). Prevalence of UIBs increased steadily as parity increased. Respondents who had given birth to two or less children had the lowest prevalence of UIBs (15.0%, CI = 14.7 – 15.2), followed by those with 3-4 previous children (20.3%, CI = 20.0 – 20.6), 5-8 (29.9%, CI = 29.4 – 30.4), and 9 or more (35.6%, CI = 34.4 – 36.8). Women who had experienced a pregnancy termination (e.g., miscarriage, abortion, stillbirth) at some point prior to the reference birth had an UIB prevalence of 19.4% while those who had not had a pregnancy termination also had an UIB percentage of 19.4%. Women who reported knowing a modern method of contraception had a prevalence of 19.5% while women who did not know a modern method had a prevalence of 16.0%. If the respondent knew a source of FP they had a higher prevalence of UIBs (19.5%) than if the respondent did not know a source of FP (14.6%). Respondents who had knowledge of emergency contraception had a prevalence of 18.5% while it was 18.4% in those without knowledge.

All variables presented in Table 2 had statistically significant ($p<0.001$) bivariate associations with UIBs with the exception of history of pregnancy termination ($p=0.898$) and knowledge of emergency contraception ($p=0.745$). Therefore, these variables were excluded from the multivariate logistic regression models.

Table 2: Prevalence of unintended births and bivariate analyses across sociodemographic, sexual, and reproductive health variables

Variables	Sample size and percent of total	Unintended Births	Bivariate Significance
	n (column %)	n (row %, 95% CI)	χ2 (p-value)
Respondent's Age			871.1 (<0.001)
15 - 20 years	37701 (10.1)	9826 (25.0, 24.4 – 25.6)	
21 - 30 years	226414 (60.4)	36228 (16.3, 16.1 – 16.6)	
31 - 40 years	99137 (25.1)	20955 (22.2, 21.8 – 22.6)	
41 - 49 years	17325 (4.3)	5305 (32.3, 31.4 – 33.2)	
Urban/Rural			41.9 (<0.001)
Urban	108658 (31.2)	22636 (20.5, 20.0 – 20.9)	
Rural	271919 (68.8)	49678 (18.9, 18.6 – 19.1)	
Respondent covered by health insurance?			382.0 (<0.001)
Yes	38412 (11.2)	5235 (13.3, 12.8 – 13.8)	
No	318205 (88.8)	60270 (19.4, 19.2 – 19.7)	
Current Marriage Status			6772.2 (<0.001)
Never Married	15515 (4.0)	9653 (63.4, 62.4 – 64.4)	
Currently Married	347594 (91.6)	56656 (16.7, 16.5 – 16.9)	
Formerly Married	17468 (4.5)	6005 (35.7, 34.8 – 36.7)	
Education of Respondent			1023.9 (<0.001)
None	119243 (30.5)	18181 (15.9, 15.6 – 16.3)	
Primary	96149 (25.2)	26438 (28.0, 27.6 – 28.4)	
Secondary	137622 (36.3)	24677 (18.1, 17.8 – 18.4)	
Higher	27549 (8.1)	3015 (11.0, 10.4 – 11.5)	
Wealth Index Quintile			9.1 (<0.001)
Poorest	79970 (22.7)	14485 (19.3, 18.9 – 19.7)	
Poorer	73191 (21.0)	13629 (19.6, 19.2 – 20.0)	
Middle	65949 (19.9)	12648 (19.2, 18.8 – 19.7)	
Richer	58864 (19.2)	11089 (18.7, 18.2 – 19.2)	
Richest	53160 (17.2)	9338 (17.8, 17.3 – 18.3)	
Occupation			133.6 (<0.001)
Not Working	80474 (37.0)	18247 (23.1, 22.7 – 23.5)	
Professional/Clerical	47614 (23.4)	12322 (26.2, 25.6 – 26.8)	
Agricultural	66289 (30.1)	19088 (29.3, 28.8 – 29.8)	
Manual/Household Labor	19842 (9.5)	6441 (33.1, 32.2 – 34.0)	
Armed Forces	151 (0.1)	71 (45.1, 34.2 – 56.6)	
Religion			1388.7 (<0.001)
Muslim	76460 (21.7)	10881 (14.9, 14.4 – 15.3)	
Catholic	32971 (9.3)	11563 (35.1, 34.3 – 35.8)	
Orthodox	2376 (0.8)	591 (27.4, 24.9 – 30.0)	
Protestant	28711 (8.2)	10513 (36.9, 36.1 – 37.8)	
Other Christian	62551 (14.3)	18329 (34.2, 33.6 – 34.9)	
Buddhist	2261 (0.5)	197 (9.4, 6.9 – 12.6)	
Hindu	141750 (42.4)	12965 (9.1, 8.9 – 9.4)	
Sikh	3234 (0.7)	207 (6.2, 5.2 – 7.4)	
Other	4787 (1.0)	887 (19.5, 17.7 – 21.4)	
No Religion	3757 (1.1)	1034 (27.7, 25.6 – 29.9)	
Age when respondent first had sex			431.0 (<0.001)
11 years and under	3857 (1.0)	945 (24.1, 22.4 – 25.9)	
12 – 15 years	87737 (24.3)	21190 (24.1, 23.7 – 24.5)	

16 – 19 years	173763 (48.2)	34794 (20.3, 20.0 – 20.5)	
20 – 29 years	98072 (25.8)	12430 (13.2, 12.9 – 13.6)	
30 years and above	2861 (0.6)	206 (8.4, 6.8 – 10.2)	
Lifetime Number of Sexual Partners			784.0 (<0.001)
One	131016 (62.6)	27524 (21.6, 21.3 – 22.0)	
2 - 5	73076 (34.9)	25414 (34.7, 34.1 – 35.2)	
6 - 10	3822 (1.8)	1306 (35.8, 33.7 – 37.9)	
11 or more	1719 (0.8)	464 (27.6, 24.9 – 30.5)	
Age when first married			51.5 (<0.001)
9 years and under	1260 (0.4)	169 (14.0, 11.4 – 17.1)	
10 -15 years	68963 (19.6)	12857 (18.5, 18.1 – 18.9)	
16 – 20 years	193026 (53.7)	34612 (18.3, 18.0 – 18.6)	
21 – 30 years	94687 (25.3)	14080 (15.5, 15.2 – 15.9)	
31 years and over	4254 (1.0)	627 (16.5, 15.0 – 18.1)	
Duration of Current Marriage			3977.1 (<0.001)
9 years or less	218324 (58.2)	31545 (14.7, 14.5 – 14.9)	
10 – 19 years	113836 (29.5)	22018 (20.0, 19.7 – 20.4)	
20 years or more	29965 (7.7)	8776 (30.2, 29.5 – 30.9)	
Number of Unions			6226.4 (<0.001)
One	338465 (89.0)	55317 (16.7, 16.5 – 16.9)	
Two or more	26476 (7.0)	7321 (28.0, 27.3 – 28.8)	
Respondent's Parity			1741.5 (<0.001)
2 or less	201956 (54.6)	30256 (15.0, 14.7 – 15.2)	
3 - 4	103549 (26.3)	19959 (20.3, 20.0 – 20.6)	
5 - 8	65151 (16.5)	18649 (29.9, 29.4 – 30.4)	
9 or more	9921 (2.6)	3450 (35.6, 34.4 – 36.8)	
History of Pregnancy Termination			0.02 (0.898)
Yes	57218 (15.2)	10813 (19.4, 18.9 – 19.8)	
No	323340 (84.8)	61494 (19.4, 19.1 – 19.6)	
Family Planning Knowledge			33.4 (<0.001)
Knows modern method	369066 (97.4)	70564 (19.5, 19.2 – 19.7)	
Does not know modern method	11511 (2.6)	1750 (16.0, 15.0 – 17.1)	
Respondent knows source of family planning			346.9 (<0.001)
Yes	133424 (65.8)	25958 (19.8, 19.5 – 20.2)	
No	73271 (34.2)	10343 (14.6, 14.1 – 15.0)	
Has Knowledge of Emergency Contraception?			0.11 (0.745)
Yes	137804 (38.7)	24821 (18.5, 18.2 – 18.8)	
No	219537 (61.3)	39961 (18.4, 18.2 – 18.7)	
Notes: Frequencies are raw counts, whereas percentages and 95% confidence intervals are weighted. Bivariate significance is based on the second-order Rao-Scott adjusted chi-square statistic.			

Table 3 shows frequencies and percentages of UIBs across variables regarding aspects of the respondent's partner and interpersonal relationships. Women whose partner was 10-15 years

of age at the reference birth had an UIB prevalence of 21.2% (CI = 16.3 – 27.0); however, this overlapped with those whose partner was 21-30 years old (21.3%, CI = 20.8 – 21.7), 31-40 years old (21.6%, CI = 21.2 – 22.0), 41-50 years old (25.3%, CI = 24.7 – 25.9), and 51 years and over (24.7%, CI = 23.8 – 25.5). The highest prevalence of UIBs, whose CI did not overlap with the other age categories, were seen in women whose partner was 16-20 years old (30.0%, CI = 27.3 – 32.7). Women whose partner had no education (16.8%, CI = 16.3 – 17.3) and 'higher' education (17.5%, CI = 16.7 – 18.3) had the lowest prevalence of UIBs as opposed to women whose partner had a primary school education (28.9%, CI = 28.4 – 29.4), which had the highest. Women whose partners were not working had the highest prevalence of UIBs (27.6%, CI = 26.3 – 29.0), while women whose partners had professional/clerical occupations had the lowest UIB prevalence (21.3%, CI = 20.8 – 21.9), although this CI overlapped with other occupational categories. Respondents who stated they made their own healthcare choices had an UIB rate of 24.3%, whereas women who stated another family member made their healthcare choices for them had an UIB rate of 19.9%. Women who believed that their being beaten was justified if they refused sex from a partner had an UIB prevalence of 27.6% while women who did not believe their being beaten was justified due to the refusal of sex was 26.0%. Lastly, women who had reported ever having sex forced on them by an intimate partner had an UIB prevalence of 37.0% while the prevalence of women who had not had sex forced on them was 22.7%. Bivariate associations between variables in Table 3 and UIBs were all significant at a p-value of less than 0.001, with the exception of believing that being beaten was justified for the refusal of sex, which was significant at a p-value of exactly 0.001.

Table 3: Prevalence of unintended births and bivariate analyses across partner and interpersonal variables

Variables	Sample size and percent of total	Unintended Births	Bivariate Significance
	n (column %)	n (row %, 95% CI)	χ2 (p-value)
Partner's age at reference birth			45.9 (<0.001)
10 – 15 years	303 (0.2)	70 (21.2, 16.3 – 27.0)	
16 – 20 years	1730 (0.9)	528 (30.0, 27.3 – 32.7)	
21 – 30 years	60593 (31.8)	12816 (21.3, 20.8 – 21.7)	
31 – 40 years	77259 (40.5)	16239 (21.6, 21.2 – 22.0)	
41 – 50 years	37019 (19.0)	9075 (25.3, 24.7 – 25.9)	
51 years and over	15382 (7.7)	3678 (24.7, 23.8 – 25.5)	
Partner's Education Level			435.4 (<0.001)
No education	53945 (27.4)	8792 (16.8, 16.3 – 17.3)	
Primary School	56299 (29.4)	16194 (28.9, 28.4 – 29.4)	
Secondary School	67365 (34.2)	15641 (23.9, 23.4 – 24.4)	
Higher	17001 (9.1)	2984 (17.5, 16.7 – 18.3)	
Partner's Occupation			28.5 (<0.001)
Not Working	8035 (4.1)	2153 (27.6, 26.3 – 29.0)	
Professional/Clerical	49851 (26.4)	10529 (21.3, 20.8 – 21.9)	
Agricultural	76845 (38.8)	16680 (22.1, 21.7 – 22.6)	
Manual/Household Labor	57681 (30.4)	13543 (24.1, 23.6 – 24.6)	
Armed Forces	572 (0.3)	146 (26.9, 21.3 – 33.2)	
Does the respondent make her own healthcare choices?			245.5 (<0.001)
Yes	116141 (59.8)	27541 (24.3, 23.9 – 24.7)	
No, other family member decides	76652 (40.2)	15012 (19.9, 19.5 – 20.3)	
Respondent believes her being beaten is justified if she refuses sex			10.8 (=0.001)
Yes	23143 (22.4)	5978 (27.6, 26.7 – 28.4)	
No	78812 (77.6)	19242 (26.0, 25.6 – 26.5)	
Has a partner ever forced sex on you?			553.7 (<0.001)
Yes	10168 (10.5)	3688 (37.0, 35.8 – 38.3)	
No	88068 (89.5)	18980 (22.7, 22.3 – 23.2)	

Notes: Frequencies are raw counts, whereas percentages and 95% confidence intervals are weighted. Bivariate significance is based on the second-order Rao-Scott adjusted chi-square statistic.

Table 4 contains the results from the logistic regression analyses. In Model 1 country alone was used as a predictor of UIBs to produce baseline unadjusted ORs. Niger was the reference group since the descriptive analysis revealed it to have the lowest prevalence of UIBs. The highest odds of UIBs in Model 1 were seen in South Africa (OR = 12.64, CI = 10.86 – 14.72), Lesotho (OR = 11.90, CI = 10.31 – 13.74), and Namibia (OR = 11.68, OR = 10.19 – 13.37). In

addition to Niger, the lowest odds of UIBs were observed in Myanmar (OR = 1.03, CI = 0.85 – 1.25) and India (OR = 1.05, CI = 0.94 – 1.18).

After controlling for sociodemographic and SRH variables in Model 2, Lesotho's odds for UIBs increased (AOR = 12.15, CI = 9.82 – 15.02), while South Africa's (AOR = 6.69, CI = 10.26) and Namibia's (AOR = 7.02, CI = 5.92 – 8.23) decreased, although these three countries remained with the highest odds for UIBs, in addition to Malawi (AOR = 7.13, CI = 6.25 – 8.14). The countries with the lowest odds of UIBs, with the exception of the Niger, were Nigeria (AOR = 1.24, CI = 1.07 – 1.42), Myanmar (AOR = 1.32, CI = 1.08 – 1.61), and India (AOR = 1.32, CI = 1.15 – 1.51). In Model 2, 15-20 year old women had the highest odds of UIBs (AOR = 1.68, CI = 1.53 – 1.84) as compared to 21-30 year olds. Urban residents had higher odds of UIBs (AOR = 1.19, CI = 1.09 – 1.29) than rural residents. Respondents without health insurance had higher odds of UIBs (AOR = 1.13, CI = 1.03 – 1.25) than those without health insurance. Women who were formerly married had the highest odds of UIBs (AOR = 1.60, CI = 1.48 – 1.73) compared to those who were currently married. Women with a secondary education had the highest odds of UIBs (AOR = 1.41, CI = 1.17 – 1.69) compared to women with 'higher' education, while women with no education had low odds of UIBs (AOR = 1.01, CI = 0.83 – 1.23). Respondents from the middle wealth index quintile had the highest odds (AOR = 1.20, CI = 1.08 – 1.34) compared to the 'richest' group. Women who cited the armed forces as their occupation had the highest odds of UIBs (AOR = 1.90, CI = 1.20 – 3.00) as compared to women who were not employed. Women belonging to no religion and all other religions besides Sikh (reference group) all had AORs with CIs that crossed 1.00, indicating no statistically significant difference in odds of UIBs based on religious membership. Women with 6-10 previous sexual partners had the highest odds of UIBs (AOR = 1.27, CI = 1.06 – 1.52) compared to women with

only one lifetime sexual partner. Women who were first married at 31 years of age or over had the lowest odds of UIBs (AOR = 0.15, CI = 0.07 – 0.37) compared to those first married at nine years of age or younger. Women with nine or more previous children had the highest odds of a subsequent UIB (OR = 5.32, CI = 4.57 – 6.19) compared to a parity of two or less. Women who knew a modern method of FP had higher odds of UIBs (AOR = 1.35, CI = 1.17 – 1.55) than women who did not know a modern method. Lastly, women who knew a source of FP had slightly higher odds of UIBs (AOR = 1.08, CI = 1.00 – 1.17) than women who did not.

After controlling for covariates about the woman's partner and interpersonal relationships in Model 3, several associations revealed in Model 2 were further clarified and some became statistically insignificant. In Model 3, Lesotho remained the country with the highest odds of UIBs (AOR = 11.13, CI = 8.54 – 14.51), whereas Nigeria was the lowest (AOR = 1.11, CI = 0.96 – 1.29). The African region had higher odds of UIBs (AOR = 2.62, CI = 2.09 – 3.29) compared to South-East Asia. Fragile countries had higher odds (AOR = 1.44, CI = 1.30 – 1.59) than non-fragile countries. Women from the 15-20 year old age group still had the highest odds of UIBs (AOR = 1.65, CI = 1.40 – 1.94) compared to 21-30 year olds, with odds continuing to decrease with older age. Urban residents still had higher odds of UIBs (AOR = 1.15, CI = 1.02 – 1.31) compared to rural residents, although the association became weaker in Model 3. The association between health insurance coverage and odds of UIB became statistically insignificant in Model 3 (p=0.138). Women who were never married had the highest odds of UIBs (AOR = 1.82, CI = 1.61 – 2.05) compared to those currently married, although their CI overlapped with formerly married women (AOR = 1.63, CI = 1.28 – 2.07). Again, women with no education (AOR = 1.32, CI = 0.96 – 1.80) and those with 'higher' education (reference) had the lowest odds of UIBs, whereas those with a primary (AOR = 1.59, CI = 1.18 – 2.16) and secondary (AOR =

1.55, CI = 1.15 – 2.08) educations had higher odds. The association between wealth index quintile and UIBs became statistically insignificant in Model 3 (p=0.091). Likewise, the association between the woman's occupation and odds of UIB became insignificant (p=0.071). While the overall p-value for the association between religion and odds of UIB was significant (p<0.001), each religion's CI as compared to members of the Sikh faith was very wide and included 1.00, meaning individual comparisons between specific religions and the reference group were not statistically significant. Age of sexual initiation became statistically insignificant in Model 3 (p=0.745). Women who had 2-5 lifetime sexual partners were the only group that had a statistically significant difference (AOR = 1.16, CI = 1.04 – 1.30) from the reference group (those with only one sexual partner in lifetime). Again, women who had first married at 31 years of age or older had the lowest odds of UIBs (AOR = 0.22, CI = 0.07 – 0.70) compared to those who had first married at nine years of age or under. Those whose marriage had a duration of 10-19 years had the lowest odds of UIBs (AOR = 0.81, CI = 0.71 – 0.92) compared to those married for nine or less years (reference group) and those married for 20 years or more (AOR = 0.99, CI = 0.80 – 1.22). Respondents with more than one union had lower odds of UIBs (AOR = 0.83, CI = 0.72 – 0.95) compared to those married only once. Again, as parity increased, the odds of UIBs increased steadily (p<0.001), and the magnitude of the AORs were greater in Model 3 than in Model 2 for each category of parity. Women who knew a modern method of FP had higher odds of UIBs (AOR = 1.45, CI = 1.19 – 1.77) compared to those who did not know a modern method. Whether or not respondent knew a source of FP became insignificant in Model 3 (p=0.177).

The woman's partner's age at the reference birth was not significantly associated with increased odds of the woman reporting an UIB (p=0.184). Women whose partner had a secondary school education had higher odds of UIB (AOR = 1.36, CI = 1.20 – 1.55) as compared

to those whose partner had no education. The respondent's partner's occupation was not clearly associated with UIBs since all CIs contained 1.00, with the reference group being men working in professional/clerical jobs. Respondents who reported making their own healthcare choices had lower odds of UIBs (AOR = 0.91, CI = 0.83 – 0.99) compared to women whose healthcare decisions were made by another family member. Respondents holding the belief that being beaten was justified if she refused sex was not associated with UIBs (p=0.658), whereas women who reported ever having sex forced on them by a partner had higher odds of UIBs (AOR = 1.48, CI = 1.36 – 1.60) compared to women who had not had sex forced on them.

Table 4: Bivariate (Model 1) and multivariate logistic regression (Models 2 and 3) results for determinants of unintended births

Variables	Model 1	p-value	Model 2	p-value	Model 3	p-value
	OR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Country		<0.001		<0.001		<0.001
African Region						
Angola (2015)	6.19 (5.35 – 7.16)		5.03 (4.24 – 5.97)		4.19 (3.56 – 5.08)	
Burundi (2016)	5.29 (4.68 – 5.99)		4.98 (4.34 – 5.72)		4.54 (3.92 – 5.27)	
Cameroon (2011)	3.79 (3.32 – 4.33)		3.00 (2.59 – 3.47)		2.64 (2.27 – 3.09)	
Dem. Rep. of Congo (2013)	4.95 (4.26 – 5.75)		3.76 (3.19 – 4.44)		3.10 (2.60 – 3.69)	
Ethiopia (2016)	3.75 (3.23 – 4.35)		3.96 (3.40 – 4.62)		3.60 (3.06 – 4.25)	
Ghana (2014)	5.08 (4.35 – 5.95)		4.32 (3.66 – 5.09)		3.71 (3.11 – 4.42)	
Guinea (2018)	2.08 (1.79 – 2.41)		1.98 (1.68 – 2.32)		1.86 (1.58 – 2.20)	
Cote d'Ivoire (2011)	3.80 (3.28 – 4.39)		3.23 (2.74 – 3.81)		2.89 (2.44 – 3.43)	
Kenya (2014)	6.93 (6.09 – 7.89)		5.74 (4.98 – 6.62)		4.97 (4.27 – 5.79)	
Lesotho (2014)	11.90 (10.31 – 13.74)		12.15 (9.82 – 15.02)		11.13 (8.54 – 14.51)	
Liberia (2013)	5.02 (4.27 – 5.90)		4.02 (3.38 – 4.78)		3.36 (2.80 – 4.04)	
Malawi (2016)	7.93 (7.03 – 8.95)		7.13 (6.25 – 8.14)		6.04 (5.25 – 6.96)	
Mali (2018)	1.96 (1.68 – 2.30)		1.87 (1.58 – 2.20)		1.80 (1.51 – 2.13)	
Mozambique (2011)	2.03 (1.77 – 2.33)		1.63 (1.41 – 1.90)		1.34 (1.14 – 1.59)	
Namibia (2013)	11.68 (10.19 – 13.37)		7.02 (5.92 – 8.23)		6.04 (4.98 – 7.34)	
Niger (2012)	Ref		Ref		Ref	
Nigeria (2018)	1.43 (1.26 – 1.63)		1.24 (1.07 – 1.42)		1.11 (0.96 – 1.29)	
Rwanda (2014)	6.75 (5.96 – 6.64)		6.17 (5.36 – 7.10)		5.50 (4.72 – 6.39)	
Senegal (2017)	2.75 (2.40 – 3.14)		2.75 (2.38 – 3.18)		2.67 (2.29 – 3.11)	
South Africa (2016)	12.64 (10.86 – 14.72)		8.29 (6.69 – 10.26)		6.62 (5.89 – 9.85)	
Zimbabwe (2015)	5.61 (4.92 – 6.39)		5.06 (4.37 – 5.85)		4.01 (3.42 – 4.70)	
Uganda (2016)	8.41 (7.43 – 9.51)		6.62 (5.78 – 7.59)		5.66 (4.89 – 6.56)	
Tanzania (2015)	5.34 (4.67 – 6.10)		4.34 (3.75 – 5.03)		3.96 (3.39 – 4.63)	
Zambia (2018)	7.11 (6.23 – 8.11)		4.76 (4.11 – 5.51)		4.18 (3.57 – 4.89)	
South-East Asian Region						
Myanmar (2015)	1.03 (0.85 – 1.25)		1.32 (1.08 – 1.61)		1.17 (0.94 – 1.44)	
India (2015)	1.05 (0.94 – 1.18)		1.32 (1.15 – 1.51)		1.12 (0.97 – 1.30)	
Nepal (2016)	2.59 (2.22 – 3.02)		3.29 (2.79 – 3.88)		2.73 (2.29 – 3.25)	
WHO Region				<0.001		<0.001
African	-		2.00 (1.67 – 2.40)		2.62 (2.09 – 3.29)	
South-East Asian	-		Ref		Ref	
Fragility				<0.001		<0.001
Non-Fragile	-		Ref		Ref	
Fragile	-		1.26 (1.17 – 1.34)		1.44 (1.30 – 1.59)	
Age at reference birth				<0.001		<0.001
15 - 20 years	-		1.68 (1.53 – 1.84)		1.65 (1.40 – 1.94)	
21 - 30 years	-		Ref		Ref	
31 - 40 years	-		0.82 (0.76 – 0.89)		0.81 (0.72 – 0.92)	
41 - 49 years	-		0.84 (0.73 – 0.97)		0.76 (0.60 – 0.97)	
Urban/Rural				<0.001		0.028
Urban	-		1.19 (1.09 – 1.29)		1.15 (1.02 – 1.31)	
Rural	-		Ref		Ref	
Respondent covered by health insurance?				0.011		0.138
Yes	-		Ref		Ref	
No	-		1.13 (1.03 – 1.25)		1.10 (0.97 – 1.26)	
Current Marriage Status				<0.001		<0.001
Never Married	-		0.78 (0.08 – 8.12)		1.82 (1.61 – 2.05)	

Currently Married	-		Ref		Ref	
Formerly Married	-		1.60 (1.48 – 1.73)		1.63 (1.28 – 2.07)	
Education of Respondent				<0.001		<0.001
None	-		1.01 (0.83 – 1.23)		1.32 (0.96 – 1.80)	
Primary	-		1.27 (1.05 – 1.54)		1.59 (1.18 – 2.16)	
Secondary	-		1.41 (1.17 – 1.69)		1.55 (1.15 – 2.08)	
Higher	-		Ref		Ref	
Wealth Index Quintile				0.001		0.091
Poorest	-		1.07 (0.96 – 1.20)		1.20 (0.99 – 1.44)	
Poorer	-		1.19 (1.06 – 1.33)		1.23 (1.02 – 1.48)	
Middle	-		1.20 (1.08 – 1.34)		1.18 (1.00 – 1.40)	
Richer	-		1.09 (0.98 – 1.21)		1.05 (0.88 – 1.24)	
Richest	-		Ref		Ref	
Occupation				<0.001		0.071
Not Working	-		Ref		Ref	
Professional/Clerical	-		1.09 (1.00 – 1.19)		1.05 (0.91 – 1.21)	
Agricultural	-		0.92 (0.85 – 0.99)		0.96 (0.86 – 1.08)	
Manual/Household Labor	-		1.01 (0.91 – 1.12)		0.93 (0.79 – 1.10)	
Armed Forces	-		1.90 (1.20 – 3.00)		2.66 (1.33 – 5.29)	
Religion				<0.001		<0.001
Muslim	-		1.65 (0.35 – 7.80)		1.65 (0.35 – 7.87)	
Catholic Christian	-		2.23 (0.47 – 10.55)		2.13 (0.45 – 10.17)	
Orthodox Christian	-		1.01 (0.05 – 22.28)		0.99 (0.04 – 24.33)	
Protestant Christian	-		2.38 (0.50 – 11.25)		2.25 (0.47 – 10.75)	
Other Christian	-		2.53 (0.54 – 11.98)		2.40 (0.50 – 11.49)	
Buddhist	-		0.23 (0.02 – 2.40)		0.23 (0.02 – 2.56)	
Hindu	-		1.52 (0.32 – 7.15)		1.48 (0.31 – 7.02)	
Sikh	-		Ref		Ref	
Other	-		1.74 (0.37 – 8.33)		1.59 (0.33 – 7.71)	
No Religion	-		2.14 (0.45 – 10.19)		2.05 (0.43 – 9.90)	
Age when respondent first had sex				0.026		0.745
11 years and under	-		1.07 (0.63 – 1.80)		1.40 (0.61 – 3.18)	
12 – 15 years	-		1.02 (0.63 – 1.66)		1.36 (0.63 – 2.91)	
16 – 19 years	-		1.06 (0.65 – 1.71)		1.40 (0.66 – 2.97)	
20 – 29 years	-		0.92 (0.57 – 1.49)		1.30 (0.61 – 2.76)	
30 years and above	-		Ref		Ref	
Lifetime Number of Sexual Partners				<0.001		0.029
One	-		Ref		Ref	
2 - 5	-		1.21 (1.13 – 1.30)		1.16 (1.04 – 1.30)	
6 - 10	-		1.27 (1.06 – 1.52)		0.95 (0.67 – 1.35)	
11 or more	-		1.12 (0.85 – 1.47)		1.19 (0.79 – 1.78)	
Age when first married				<0.001		0.018
9 years and under	-		Ref		Ref	
10 -15 years	-		0.30 (0.13 – 0.68)		0.34 (0.12 – 0.97)	
16 – 20 years	-		0.31 (0.14 – 0.71)		0.38 (0.13 – 1.08)	
21 – 30 years	-		0.28 (0.12 – 0.64)		0.36 (0.13 – 1.03)	
31 years and over	-		0.15 (0.07 – 0.37)		0.22 (0.07 – 0.70)	
Duration of Current Marriage				<0.001		<0.001
9 years or less	-		Ref		Ref	
10 – 19 years	-		0.74 (0.68 – 0.81)		0.81 (0.71 – 0.92)	
20 years or more	-		0.79 (0.69 – 0.90)		0.99 (0.80 – 1.22)	

Number of Unions				0.041		0.008
One	-		Ref		Ref	
More than one	-		0.92 (0.85 – 1.00)		0.83 (0.72 – 0.95)	
Respondent's Parity				<0.001		<0.001
2 or less	-		Ref		Ref	
3 - 4	-		1.79 (1.66 – 1.92)		1.89 (1.69 – 2.11)	
5 - 8	-		3.58 (3.26 – 3.94)		3.80 (3.26 – 4.42)	
9 or more	-		5.32 (4.57 – 6.19)		5.54 (4.37 – 7.03)	
Family Planning Knowledge				<0.001		<0.001
Knows modern method	-		1.35 (1.17 – 1.55)		1.45 (1.19 – 1.77)	
Does not know modern method	-		Ref		Ref	
Respondent knows source of family planning				0.044		0.177
Yes	-		1.08 (1.00 – 1.17)		1.08 (0.97 – 1.20)	
No	-		Ref		Ref	
Partner's age at reference birth						0.184
10 – 15 years	-		-		Ref	
16 – 20 years	-		-		2.89 (0.79 – 10.57)	
21 – 30 years	-		-		2.15 (0.62 – 7.53)	
31 – 40 years	-		-		2.14 (0.61 – 7.47)	
41 – 50 years	-		-		1.94 (0.55 – 6.79)	
51 years and over	-		-		2.16 (0.61 – 7.60)	
Partner's Education Level						<0.001
No education	-		-		Ref	
Primary School	-		-		1.11 (1.00 – 1.22)	
Secondary School	-		-		1.36 (1.20 – 1.55)	
Higher	-		-		1.27 (1.02 – 1.60)	
Partner's Occupation						0.010
Not Working	-		-		0.99 (0.82 – 1.20)	
Professional/Clerical	-		-		Ref	
Agricultural	-		-		0.89 (0.79 – 1.00)	
Manual/Household Labor	-		-		1.05 (0.93 – 1.19)	
Armed Forces	-		-		0.59 (0.34 – 1.02)	
Does the respondent make her own healthcare choices?						0.023
Yes	-		-		0.91 (0.83 – 0.99)	
No, other family member decides	-		-		Ref	
Respondent states that her being beaten is justified if she refuses sex						0.658
Yes	-		-		0.98 (0.92 – 1.06)	
No	-		-		Ref	
Has your partner ever forced sex on you?						<0.001
Yes	-		-		1.48 (1.36 – 1.60)	
No	-		-		Ref	

The reference group for the outcome variable is intended births. Reference categories for each variable were chosen based on which sub-group had the lowest prevalence of unintended births in bivariate tests of independence. Variables that had insignificant bivariate associations were not included in logistic regression analyses.

5. Discussion

Lesotho had the highest odds of UIBs after factoring in all covariates in Model 3, while Niger, Nigeria, Myanmar, and India had the lowest. The African region and fragile regions had significantly higher odds of UIBs compared to South-East Asia and non-fragile regions, respectively. Women who had the reference birth between the ages of 15 and 20 had significantly higher odds of reporting that birth as unintended compared to other ages. Further, the odds of UIBs continued to decrease as age increased. This was consistent with what Sarder et al. [46] found in South-East Asia and with what others found in regional studies [27, 28, 30, 44, 85, 86]. This is in contrast however to some regional studies [12, 40, 42, 81-83] and Ameyaw et al.'s [45] SSA study that found older age groups to have relatively high odds of UIBs. Women who were never married and formerly married (i.e., currently single) had significantly higher odds of UIBs than currently married women, which was consistent with most regional studies that investigated marital status [27, 29-31, 33, 42, 44, 85, 94, 98]. This was in contrast to Ameyaw et al. [45] who found that married women had the highest odds of UIBs. Sarder et al. [46] did not analyze marital status. Women who were married at nine years of age or under had the highest odds of UIBs, while women who were married at 31 years of age or over had the lowest, which was mostly consistent with local studies that observed decreasing odds of UIBs as age at first marriage increased [38,40,96,97]. While the sample size of women in the armed forces was very small, the odds of them having UIBs was significantly higher than all other professions. Age at first marriage and armed forces as an occupation were not investigated in either of the previous multi-country studies [45,46]. One of the strongest associations observed was between respondents' parity and UIBs. Women with two or less births had the lowest odds of a subsequent UIB, while women with 3-4, 5-8, and 9 or more previous births had greater odds

that continued to increase as parity increased. This was consistent with Sarder et al.'s [46] findings in South-East Asia and almost all regional studies [12, 25, 28, 33, 38, 40, 42, 44, 95] that accounted for parity. Women who reported making their own healthcare choices, as opposed to another family member making her healthcare choices for her, had slightly lower odds of UIBs. Notably, having input into one's own healthcare choices has previously been used as a proxy for women's empowerment [121]. Lastly, women who reported ever having sex forced on them by a partner had significantly higher odds of reporting an UIB at some point in time after the IPV event. These variables (ability to make personal healthcare choices and intimate partner rape) were not explored in the previous multi-country studies [45,46].

Several findings were intriguing owing to their somewhat counterintuitive nature. It was surprising to observe the association between health insurance coverage and decreased odds of UIBs observed in Model 2 become insignificant in Model 3 after partner and interpersonal variables were added. This could be due in part to inadequate FP outreach by health plans, and/or women who are not covered by health insurance engaging in FP at lower rates or feeling less empowered to admit to births being unintended. Other researchers are urged to investigate the interplay between health insurance coverage and UIBs. An analysis of several different types of health insurance coverage for associations with UIBs could elucidate an explanation for our statistically insignificant finding and the apparent confounding relationship between insurance status and interpersonal variables. Other interesting findings emerged with respect to educational status and SES. Although there was not statistical significance due to overlapping CIs between subcategories, an intriguing pattern was that women with no education and women with the highest education both had the lowest odds of UIBs. Likewise, women from the poorest wealth quintile and those from the richer and richest quintiles had the lowest odds of UIBs. Previous

regional-level results on education and wealth were highly mixed. Some regional studies showed that women with no education had the highest odds of UIBs [27, 29, 39, 85], while others, like ours, showed that women with no education had low odds [37, 40, 44, 81, 87, 88]. Others found no association between education and UIBs [24-26, 30, 31, 33, 38, 82, 89]. As for wealth, two regional studies, like ours, found that low SES women had lower odds of UIBs [44,94]. However, most found that lower SES predisposes a woman to higher odds of UIBs [12, 31, 39, 41, 91-93]. Our non-monotonic findings (i.e., low/high education and low/high wealth having low odds of UIBs) may indicate that women with higher education and higher wealth are empowered to the point where they have enough input into FP to result in lower odds of UIBs. On the other hand, women with no education and of the poorest wealth quintile may have reported low odds of UIBs due to not having enough influence within relationships to engage in FP decision-making or to admit to a birth being unintended. Also, they may feel that they have few professional and/or academic opportunities and therefore are not incentivized to delay pregnancies [58]. These findings, especially in a multi-country study spanning two world regions, could be further evidence of the widespread influence of women's empowerment, or lack thereof, on the reporting and collection of RMNCH and FP indicators. Another interesting finding was that women who knew a modern method of FP had higher odds of UIBs than those who did not know a modern method. This could be because women who are aware enough to know a modern method of contraception would be more likely to engage in FP and therefore more likely to recognize a birth as unintended. On the other hand, women who do not know a modern method of contraception may be engaging in FP to such a small degree, if at all, that they may not even be viewing births through the lens of them possibly being unintended. Again, findings like this highlight the importance of subsequent studies taking into consideration the

potential disconnect between births that are recognized by the woman as unintended, versus births among women that do not have the willingness, ability, and/or awareness to proactively classify them as unintended when being asked about them in a survey.

The previous multi-country studies [45,46] did not investigate aspects of the woman's partner for associations with UIBs. The few regional studies that did found that women whose partner had no income had higher odds of UIBs [31], women who had younger partners had higher odds of UIBs [12], and women whose partners were more highly educated had lower odds of UIBs [31] . Our study included several variables about respondents' partners and found that women whose husbands had no education had the lowest odds of UIBs. Again, this may be an indication that couples with lower levels of education may not be engaging in FP and therefore may not be considering births in terms of them possibly being unintended. Lastly, it was surprising to see that women that believed their being beaten was justified if they refused sex did not have higher odds of reporting UIBs. This may be due to power differentials in their relationships and their resulting inability to plan births and/or reluctance to classify births as unintended. On the other hand, women who had sex forced on them at some point in the past clearly had higher odds of subsequent UIBs. The seeming disconnect between these last two findings may illustrate an important difference in the likelihood that a woman that holds the belief that IPV is justified has of classifying a birth as unintended, as opposed to the likelihood of a woman classifying a birth as unintended who may not believe IPV is justified, but nonetheless had IPV perpetrated against her. This should be explored further so that the counseling of women with varying perceptions of the acceptability of IPV can be tailored accordingly.

There are several limitations to this project. It was based on cross-sectional surveys with self-reported measures and therefore recall and social desirability biases may be an issue,

especially with a topic as sensitive as classifying one's birth as unintended or intended. DHS datasets were not available for all LMICs and others had to be excluded, so while this study is a step toward elucidating generalizable predictors of UIBs in LMICs, it is not complete since it only accounts for two major world regions. For instance, most DHS surveys from Eastern Mediterranean countries could not be included because they did not interview single women. Being able to assess unmarried women was one of the main inclusion criteria for this analysis since one of the limitations of previous studies were that they only investigated married women [12, 25, 26, 32, 40, 44]. A more detailed investigation of some intriguing findings was not possible due to dataset limitations. For example, an in-depth analysis of the association between different types of health insurance and UIBs could not be done with the current DHS data since they only inquired about health insurance coverage as a general 'yes' or 'no' question. Also, the finding of a high rate of UIBs among women in the armed forces must be interpreted with caution due to their small sample size. Despite these limitations, this study has several strengths. The DHS IPUMS data management tool allowed for standardization and comparability across our large number of nationally representative datasets. DHS surveys are also regularly repeated, so easily harmonized follow-up analyses will be possible. While all LMICs were not able to be included, this project was largely able to represent two of the most expansive, primarily LMI regions in the world. Therefore, this is the first study to investigate determinants of UIBs across not only many countries, but across world regions as well, which can help researchers understand the underlying basic concepts of what leads to UIBs. In addition, several novel variables that have not been previously investigated in multi-country studies, or only studied in a limited manner in regional studies, were included.

In closing, the results indicate that many countries, especially those in SSA, should refocus efforts on SRH and FP due to their having both high rates and high odds of UIBs after controlling for a variety of geographic, sociodemographic, and interpersonal covariates. In particular, governments and donors working in Lesotho, Malawi, Namibia, and South Africa should devote more resources toward FP outreach since these countries had the highest odds of UIBs. Stakeholders are encouraged to pay special attention to the issue of UIBs in fragile settings and SSA since they had higher odds of UIBs than non-fragile regions and South-East Asia, respectively. SRH practitioners are advised, when they do not have context-specific studies from which they can inform their practice, to focus their UIB prevention efforts on:

- Women 20 years of age and younger;
- Women who have never been married and also those divorced (i.e., currently single);
- Women who have been subjected to child marriage at the age of nine or younger;
- Women with high parity, with efforts increasing as parity increases;
- Women who admittedly have their personal healthcare choices made at the discretion of another family member (e.g., partner, parent, or otherwise); and
- Women who reported having had sex forced on them at some point in the past.

Moving beyond these implementation-centric recommendations, researchers should build on this project by studying UIBs while factoring in other world regions and investigating the aforementioned 'counterintuitive' findings. Especially, effort should be put into determining why women with no education, women of the poorest wealth quintile, and women whose partners had no education exhibited relatively low odds of UIBs. The odds of UIBs among women in the

armed forces should be investigated with a larger sample size. The potential association between religion and UIBs should be further researched since our results on this issue were not particularly useful due to wide CIs. Religion has been indicated in other works to have an important effect on UIBs [36, 38, 39, 41, 44, 85, 90, 94, 98]. Since several of the associations observed in Model 2 (e.g., health insurance coverage, wealth, occupation, age at sexual initiation, and knowledge of a FP source) lost statistical significance after adding the Model 3 variables, it is recommended that researchers take family dynamic indicators into account in subsequent UIB analyses and elucidate any confounding mechanisms between these categories of variables. Lastly, the DHS program and other surveys are encouraged to not only continue, but also expand upon their collection of indicators regarding family dynamics among women of reproductive age in LMICs. Having more of these variables available for a wider array of countries will allow for more robust intercountry comparisons and pooled analyses, while hopefully shedding light on some of the questions brought forth in this project.

6.0 Conclusion

This study was an important first step in elucidating a conceptual understanding of generalizable factors in women's lives that place them at higher risk for UIBs in LMICs. It studied several sociodemographic, SRH, intimate partner, and interpersonal variables that previous multi-country studies and most regional studies did not. This in part clarified previous findings and indicated the importance of considering family dynamic variables since several of the associations seen in Model 2 lost significance after the addition of these variables in Model 3.

The final model indicated that women 20 years of age and younger; women not currently married; women married prior to the age of nine years; women with high parity; women who have their healthcare choices made for them by a family member; and women who had sex forced on them are at clearly defined, higher risk for UIBs. Several findings are also compelling with respect to guiding the direction of future research. Researchers are encouraged to investigate why this study revealed that women of low SES and women with no education had similar odds of UIBs as those of the highest SES and education categories, respectively. It should be determined if the lower odds of UIBs in women of low SES, no education, without knowledge of modern contraceptives, and those whose partners have no education indicate that decreased levels of empowerment lead to a lack of effective FP and/or women feeling unable to classify births as unintended. Lastly, the effect of health insurance on UIBs and UIBs among female military members should be examined in specialized studies.

7.0 References

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