Modeling Global Historical Trends in Conditional Unintended Birth Rates by Moving towards a More Specific Definition of Fertility Intention

Jessica Rosenberg[1], Jewel Gausman[1], Jonathan Bearak[1]
[1]Guttmacher Institute

Introduction

A woman's ability to achieve her fertility intentions, namely whether or not to have a child, is a central tenant of reproductive agency. Researchers have documented strong associations between unintended pregnancies and adverse health and economic outcomes. As such, accurately documenting the incidence of unintended fertility is critical for crafting strategies and interventions that can lead to improved sexual and reproductive health outcomes.

Myriad studies have analyzed levels and trends in unintended pregnancies and births across geographic regions (Bearak et al. 2022, 2020, 2018; Sedgh, Singh, and Hussain 2014; Singh, Sedgh, and Hussain 2010) and in individual countries (e.g., Chae et al. 2017; Chalise et al. 2022; Kost & Zolna 2023; Polis et al. 2017; Tenaw et al. 2022). As a rule, these studies report rates that relate the number of unintended pregnancies or births to the number of women of reproductive age (generally ages 15-44 or 15-49) to contextualize the total number of pregnancies or births relative to population size. Since this denominator ignores fecundity, sexual activity, and fertility intentions, this means that women who are not able to become pregnant, as well as women who want to become pregnant, are included in the denominator.

Two recent studies have explored how using the standard denominator for general fertility rates fails to capture differences across countries and periods in women's success in implementing their preferences for fertility regulation (Bearak et al. 2023; Casterline & El Zeini 2022). Casterline & El Zeini proposed measuring unwanted births – those that occurred to women who wanted no more children – relative to the number of women who wanted to stop childbearing. Subsequently, Bearak et al. proposed measuring unintended pregnancies – those that occurred to women who wanted to stop, space, or postpone childbearing – relative to the number of women considered to be at risk of unintended pregnancy. They termed these measures "conditional" rates of unwanted births and unintended pregnancies, respectively. They argued that conditional rates more closely relate to women's reproductive agency than standard metrics. Using their new indicators, both studies found that standard measures substantially underestimated gains over time in women's success in implementing their fertility preferences.

In this study, we build on this research in three ways. First, we introduce a conditional unintended birth rate (CUBR). This contrasts with Bearak et al. 2023, which analyzed a conditional unintended pregnancy rate (CUPR), and Casterline et al. 2022, which studied only unwanted births. Second, we estimate trends from 1985 to 2019, whereas the most recent analysis comparing the incidence of unintended births across geographic regions analyzed ten fewer years of data (Bearak et al. 2018). Third, we introduce a refined measure of the denominator for conditional unintended fertility rates.

As a proxy for women of reproductive age wanting to avoid pregnancy, Bearak et al. (2023) used the definitions developed since the 1970s for the estimation of demand for and use of contraception. These include women who are either contraceptive users or who are considered to have an unmet need for family planning. Women with an unmet need for family planning are non-users of contraception who are fecund and sexually active, those who do not want any/more children, or who do not want another child for at least two years (or who are undecided about the timing of their next birth) (Bradley et al. 2012). Unmet need also assumes that all married/in union women are sexually active and defines sexual activity for unmarried women as within a 30-day recency window (Bradley et al. 2012). The established definition of contraceptive need has been widely critiqued for several reasons, and many are engaged in

the development of person-centered indicators of desire or intent and use of contraception. In our study, we aim to define and calculate a denominator that is more suitable for measuring unintended fertility and use this denominator to estimate women's success in avoiding unintended births.

In this analysis, we present estimates of CUBRs by five-year time periods from 1985 through 2019. In so doing, we expand upon the most recently published global trends of unintended births (Bearak et al. 2018) by including an additional ten years of data. Our approach also expands upon the recent literature on conditional fertility measures by refining the denominator, replacing the unmet need construct.

Methods

Data

Data were obtained from 222 Demographic and Health Surveys (DHS) spanning 75 countries for which fieldwork was conducted between 1985 and 2019. These 75 countries are clustered within 16 subregions and 5 regions. We drew numbers of unintended births, reproductive-age women (15-44), women with a contraceptive "demand", and women at risk of unintended pregnancy directly from the DHS datasets. We limited women of reproductive age to those 15-44 due to limited pregnancy data availability among women 45-49. Datasets were eligible for inclusion only if they had sufficient underlying information from which to construct the denominator of *at risk of unintended pregnancy*.

Table 1: DHS Datasets Included by Geographic Region

Region	Number of DHS Datasets
Central Europe, Eastern Europe, and Central Asia	16
Latin America and the Caribbean	41
North Africa and Middle East	6
South Asia, Southeast Asia and Oceania	36
Sub-Saharan Africa	123

Denominator and Outcome Definitions

Our measure of women at risk of unintended pregnancy differs in several ways from the contraceptive demand indicator. By the contraceptive demand indicator, we specifically refer to the DHS measure used in estimating progress toward Sustainable Development Goal 3.7.1, the proportion of women ages 15-49 who use or are considered to need family planning—hereafter, for ease of exposition, "demand." Firstly, the demand construct assumes that all married/in union women are sexually active, which leads to an overestimate of sexual activity in this population (Bradley & Casterline 2014; Ueffing et al. 2020). In response to this limitation, our denominator includes only sexually active women, defined as having had sex within the last 30 days, irrespective of their marital status. Secondly, demand includes all women using contraception regardless of their sexual activity and fertility preferences. However, many women use contraception for non-family planning purposes. To address this, the modified denominator does not consider contraceptive use. Lastly, demand includes women who want to postpone or space childbearing only if they do not want another child for at least two years. In contrast, we include those women who wish to space or postpone their next birth for less than two but more than one year. We chose a one-year period to align our numerator and denominator, as, considering the typical gestation period of pregnancies, this more closely corresponds to the question women respond to about whether their pregnancy was desired, which captures whether they wanted to become pregnant by the time they conceived.

In this analysis, we estimate and compare three unintended birth rates. We defined these three rates as follows:

Including all reproductive aged women 15-44 in the denominator, we construct the unconditional unintended birth rate (UUBR) as:

$$UUBR = \frac{Number\ of\ unintended\ births}{Number\ of\ women\ 15-44} * 1000$$

Using women with a contraceptive "demand" as the denominator, we construct the $CUBR_{demand}$ as:

$$CUBR_{demand} = \frac{Number\ of\ unintended\ births}{Number\ of\ women\ 15-44\ with\ a\ contracptive\ "demand"} * 1000$$

Utilizing women identified as *at risk of unintended pregnancy* as the denominator, we construct the $CUBR_{atrisk}$ as:

$$\mathrm{CUBR}_{\mathrm{atrisk}} = \frac{\text{Number of unintended births}}{\text{Number of women } 15-44 \text{ at risk of unintended pregnancy}} * 1000$$

We defined a birth as unintended if the woman surveyed retrospectively reported that she did not want the child by that time or at all at the time of pregnancy. We narrowed our analysis to include births occurring within 36 months prior to the date of interview.

Modeling

We produced estimates for the UUBR, the $CUBR_{demand}$ and the $CUBR_{atrisk}$ for 157 countries for each five-year time period spanning 1985 to 2019 for women 15-44 by estimating a Bayesian hierarchical time series model with these data. We fit our model to the estimates of the three undesired birth rate measures from all included DHS datasets, taking survey design into account. In the model, the predictor was the number of women included in each respective denominator and the dependent variable was the number of undesired births. The model has no intercept and all coefficients were constrained to be positive.

The model's hierarchical nature allowed for information to be exchanged on the undesired birth rates and on changes between countries clustered within subregions and regions. The model assumes that rates will be more similar within subregions and regions than between them. In the model, we used the Global Burden of Disease classification of subregions and regions based on regions and super-regions, respectively (Global Burden of Disease Collaborative Network, 2024). We excluded East Asia from the model due to unavailable input data.

The model allowed for the exchange of information across time periods by modeling temporal correlations in parameters using hierarchical random walks. The model did not make assumptions about temporal patterns. We used a Markov Chain Monte Carlo algorithm, implemented using JAGS 4.3.0, to generate samples of the posterior distributions of all model parameters, and we carried out our analysis using R 4.4.2. Point estimates are medians from the posterior distributions, and 95% uncertainty intervals (UI) were computed using the percentile method.

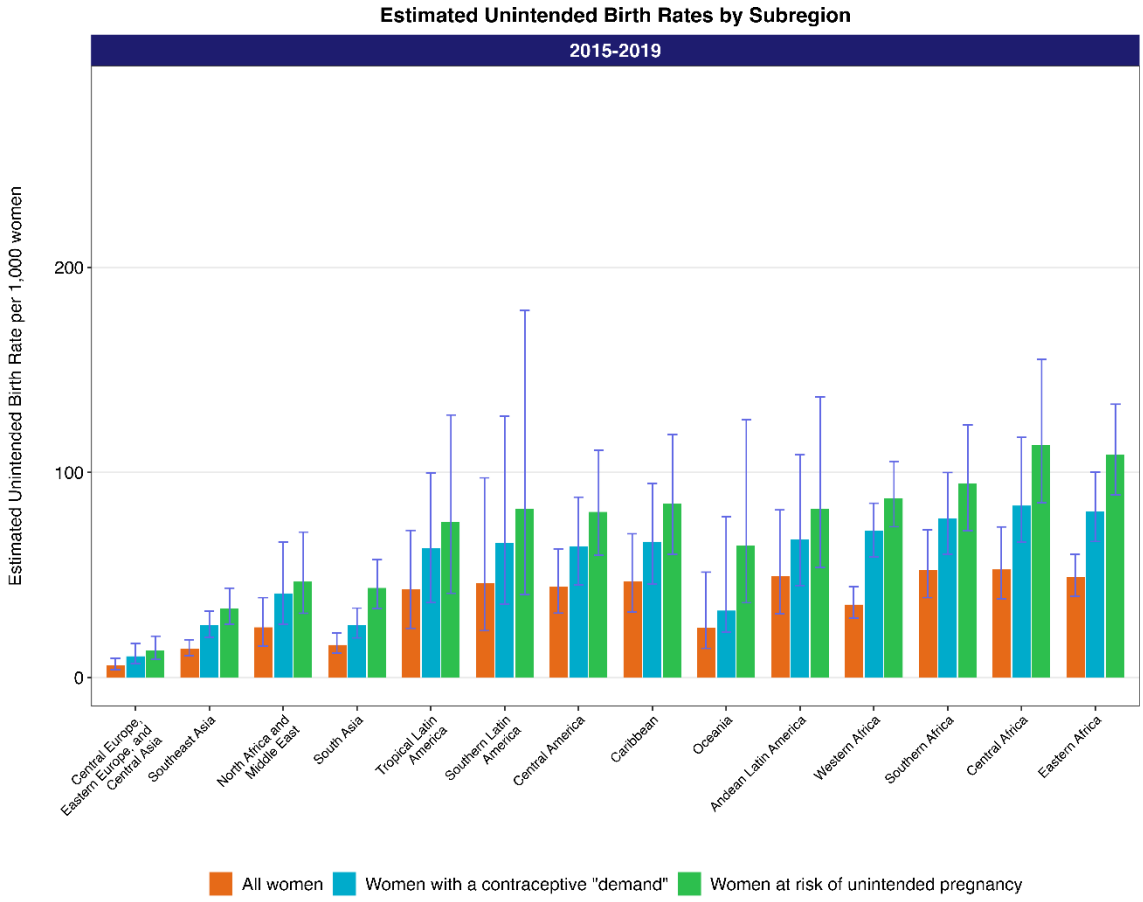
Results

Unintended birth rates in the most recent time period, 2015-2019

In the 2015-2019 time period, we observe large differences in the estimates of unintended birth rates across geographies. At a regional level, the largest differences are between Central Europe, Eastern Europe, and Central Asia and Sub-Saharan Africa. Unintended birth rates in Sub-Saharan Africa are between 7.6 and 8.3 times higher than those in the Central Europe, Eastern Europe, and Central Asia region. If we examine these comparisons at the subregional level within Sub-Saharan Africa, we find the greatest disparities between Central Africa and Central Europe, Eastern Europe, and Central Asia (ranging from 8.1 to 9.2 times as high) and the smallest disparities between Western Africa and Central Europe, Eastern Europe, and Central Asia (ranging from 6.2 to 6.9 times as high). In most subregions, the magnitude of difference for the UUBR is highest, followed by the $CUBR_{atrisk}$, and lastly by the $CUBR_{demand}$ (except for in Western Africa). Although we observe differences in magnitude by denominator, the differences are not drastic. Thus, regardless of the denominator used, the magnitude of the disparity in women's success in achieving their desired fertility intentions between the Central Europe, Eastern Europe, and Central Asia region and Central Africa is roughly the same.

Table 2: Subregional Unintended Birth Rates per 1,000 Women by Denominator for Central Europe, Eastern Europe, and Central Asia and Sub-Saharan Africa for 2015-2019

Region/Subregion	UUBR	$CUBR_{demand}$	$CUBR_{atrisk}$
Central Europe, Eastern Europe, and Central Asia	5.7	10.4	13.1
Central Africa	52.6	83.7	113.3
Eastern Africa	49.0	80.8	108.6
Southern Africa	52.4	77.5	94.7
Western Africa	35.5	71.5	87.4

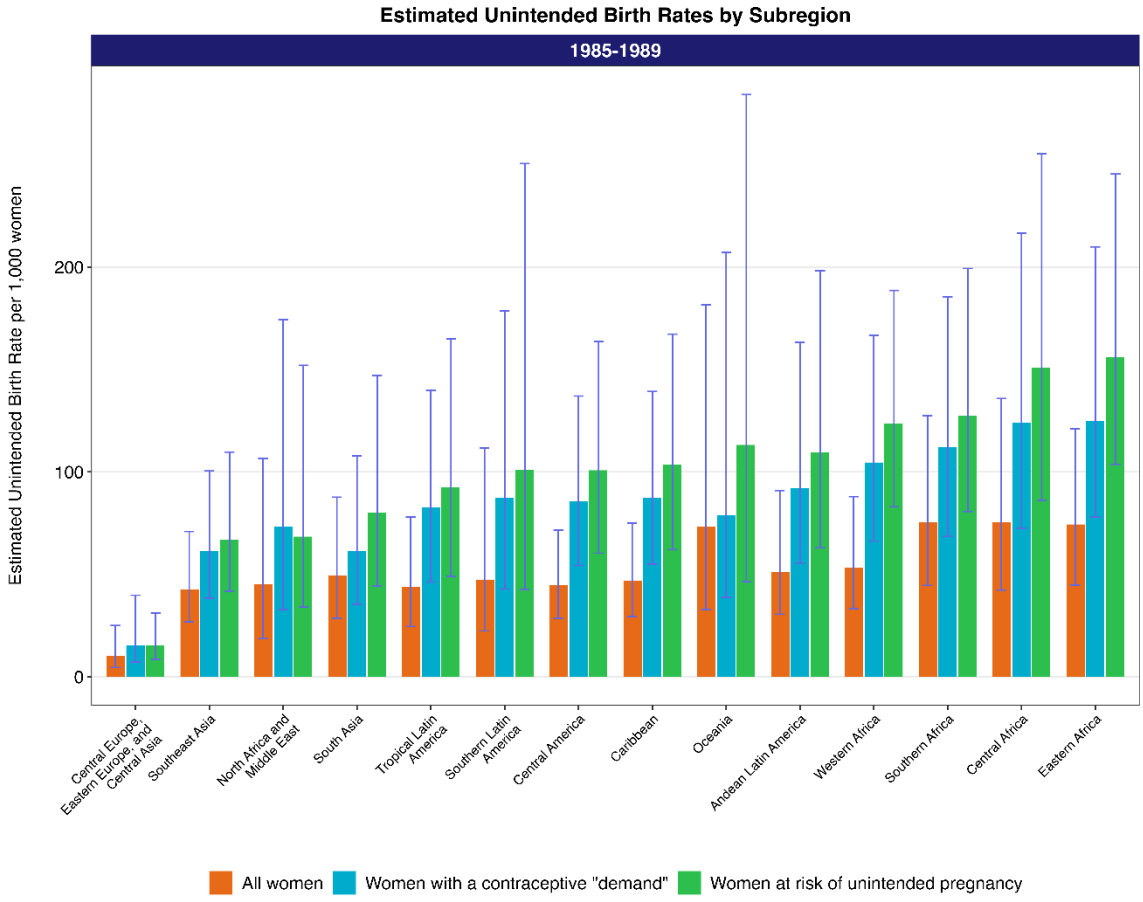


Unintended birth rates in the earliest time period, 1985-2019

For the 1985-1989 time period, we observe similarly large differences in unintended birth rates by geography regardless of which denominator is used. At a regional level, unintended birth rates in Sub-Saharan Africa are between 6.9 and 8.8 times higher than those in the Central Europe, Eastern Europe, and Central Asia region. At the subregional level, we find the greatest disparities between Eastern Africa and Central Europe, Eastern Europe, and Central Asia (ranging from 7.4 to 10.1 times as high) and the smallest disparities between Western Africa and Central Europe, Eastern Europe, and Central Asia (ranging from 5.3 to 8.0 times as high). Interestingly, in this time period we find that the magnitude of difference for the $CUBR_{atrisk}$ is highest, followed by the $CUBR_{demand}$, and lastly by the UUBR for all Sub-Saharan Africa subregions. The overall larger disparities by geography for the earliest time period when compared to the later time period indicates that there has been progress in reducing disparities over time.

Table 3: Subregional Unintended Birth Rates per 1,000 Women by Denominator for Central Europe, Eastern Europe, and Central Asia and Sub-Saharan Africa for 1985-1989

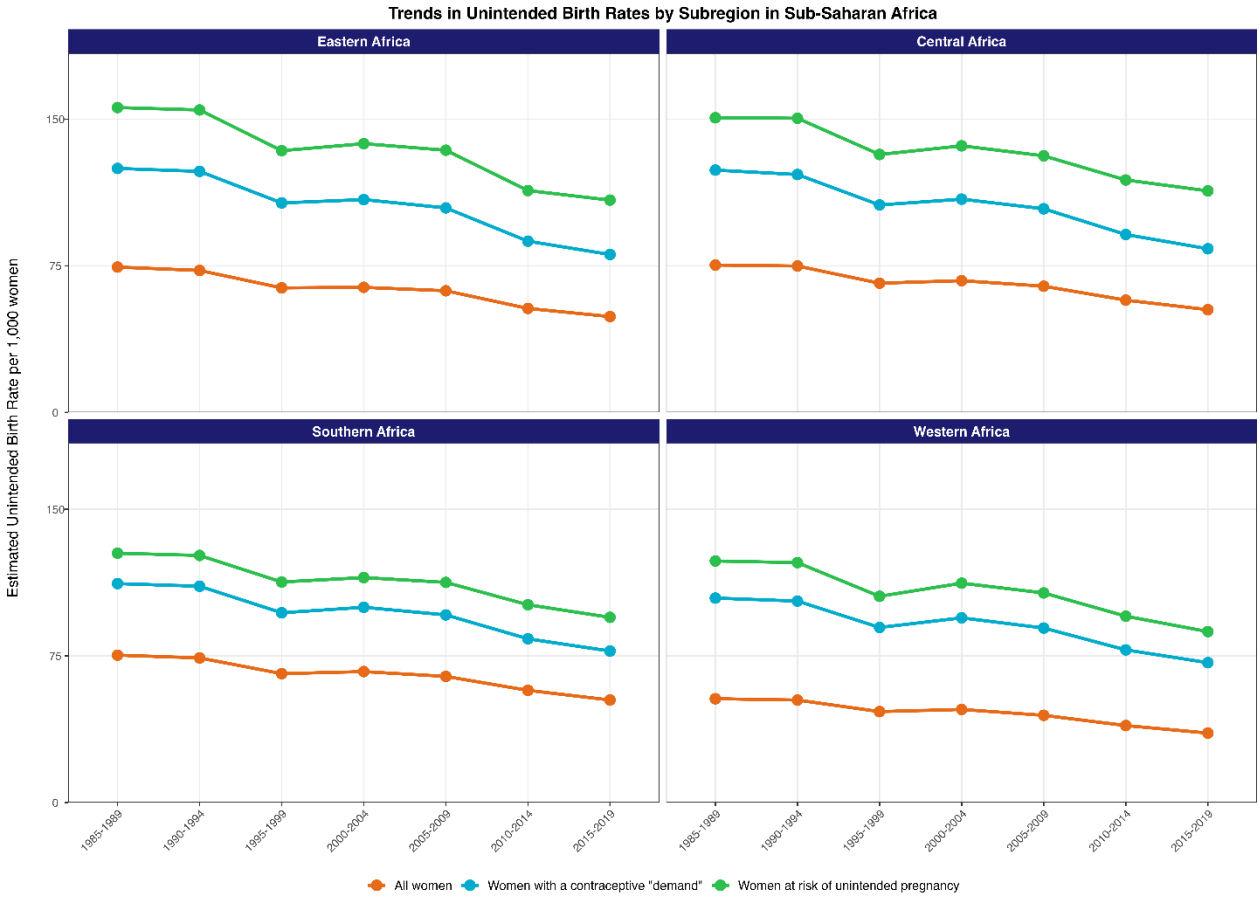
Region/Subregion	UUBR	$CUBR_{demand}$	$CUBR_{atrisk}$
Central Europe, Eastern Europe and Central Asia	10.1	15.3	15.5
Central Africa	75.4	124.0	150.7
Eastern Africa	74.4	124.8	155.9
Southern Africa	75.4	112.0	127.5
Western Africa	53.1	104.6	123.5



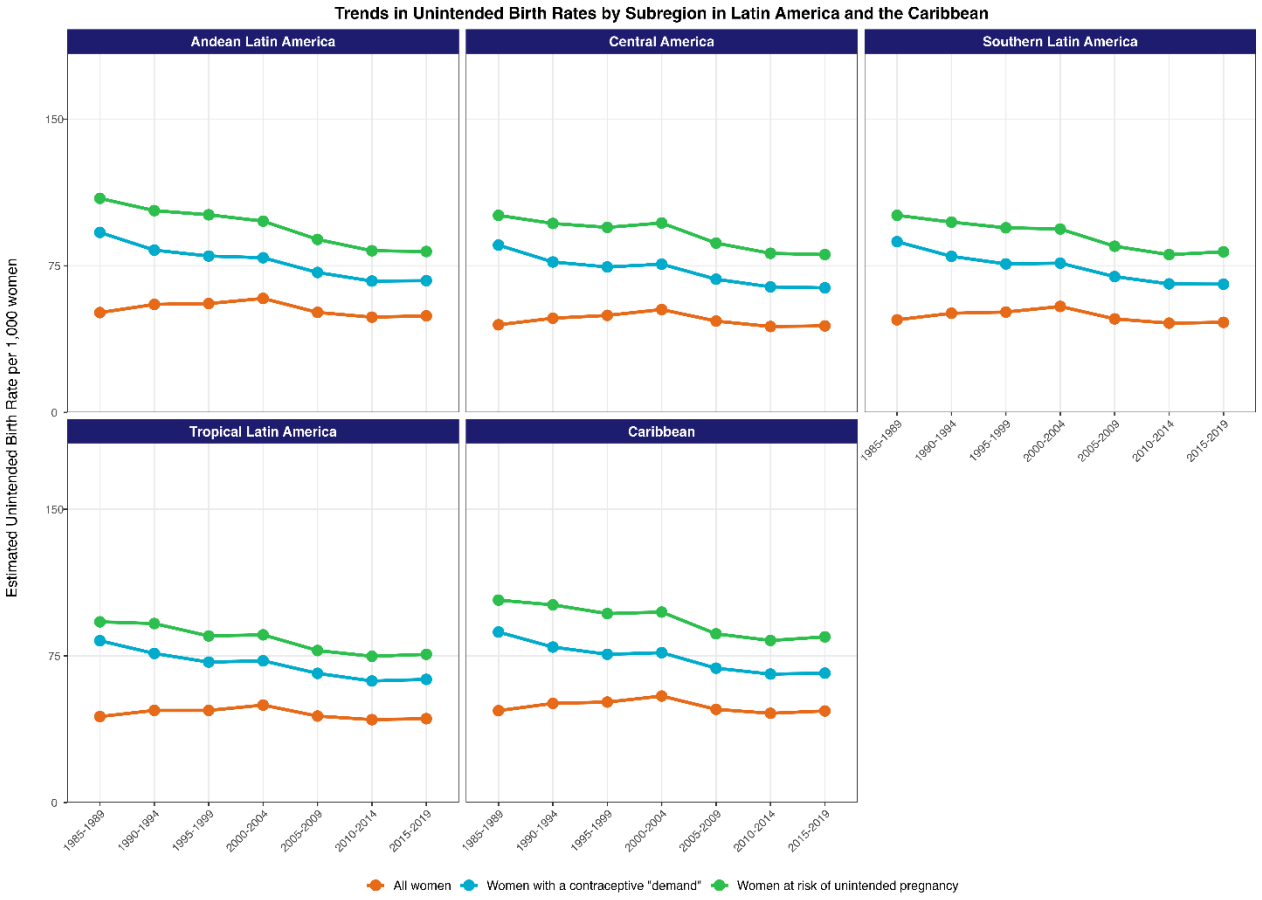
Trends in unintended birth rates over time

All three measures of unintended birth rates indicate declines in unintended fertility across time. Across all regions, unintended birth rates measured using all women as the denominator are lowest, followed by the rates using women with contraceptive "demand" as the denominator, and lastly by the rates using women at risk of unintended pregnancy as the denominator. Therefore, unconditional rates underestimate the incidence of unintended births across time and geographic regions

We observe the largest declines over time for conditional unintended measures compared with the unconditional unintended birth rate. While all geographic regions demonstrate progress over time in reducing unintended fertility, the magnitude of such declines varies widely by geographic area. Sub-Saharan Africa experienced the largest declines in unintended fertility from 1985-1989 to 2015-2019. We find that in this region, the unconditional rate and the conditional rate with the contraceptive "demand" indicator both underestimate rates of unintended births across time periods and overestimate progress in achieving fertility declines over time. The conditional rate with the at risk of unintended pregnancy denominator indicates a decline of 26% from 1985-1989 to 2015-2019 whereas the unconditional rate and the conditional rate using the contraceptive "demand" indicator both show a decline of about 32% over this same timeframe. At the subregional level, the rate of decline for the conditional at risk of unintended pregnancy rate ranges from 25% to 30% whereas the rate of decline for the unconditional rate and the conditional rate with the contraceptive "demand" denominator range from 30% to 35%.



In Latin America and the Caribbean, we find that the unconditional unintended birth rate demonstrates relatively little progress over time, with a decline of only 2%. The conditional rates show much larger declines of 19 to 25% over this same time period. At the subregional level, the rate of decline for the unconditional rate ranges from 0.3 to 3% whereas the rates of decline for the conditional rates range from 18% to 27%.



Discussion

Depending on the subregion considered, conditional or unconditional rates may reveal greater declines over time, proportionately, in women's success in avoiding unintended births. In the regions of Central Europe, Eastern Europe, and Central Asia, South Asia, Southeast Asia, and Oceania, and North Africa and the Middle East, the largest declines over time are for the unconditional unintended birth rates. For Latin America and the Caribbean, the largest declines over time are for the conditional unintended birth rates. For Sub-Saharan Africa, the magnitude of decline for conditional and unconditional birth rates are very similar, with most subregions having slightly greater declines for conditional than unconditional rates.

Comparing proportionate differences across subregions within the most recent time period, we find similar results regardless of whether we use conditional or standard rates. This may appear to contrast with the findings of Bearak and colleagues (2023) who studied unintended pregnancies (whereas we study unintended births). They found that even in the most recent time period, standard rates underestimated proportionate differences between the least and most well-resourced regions. However, their analysis included Western Europe, the United States, Canada, Australia and New Zealand. Our observations are comparable to those noted by Casterline & El-Zeini (2022) in their study analyzing births to women who wanted no more children among DHS countries. Similarly, we find that among LMIC subregions alone, conditional rates reveal more substantial time trends, but do not reveal greater proportionate disparities between regions.

While unconditional unintended birth rates estimate how common unintended births are, conditional rates assess women's success in avoiding unintended births. Although the conditional rate using contraceptive "demand" appears to better approximate unintended births than the unconditional rate, it still underestimates the incidence of unintended births. The conditional rate using the denominator at risk of

unintended pregnancy may better capture women's success in achieving their fertility desires than previous measures.

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