Change in Fertility Intentions in the First Year of COVID-19: Evidence from Four Countries in Sub-Saharan Africa

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Recent evidence suggests that women in high-income countries desired to delay or forgo childbearing due to COVID-19, yet there remains insufficient evidence of COVID-19's impact on fertility desires in low- and middle-income countries, particularly in sub-Saharan Africa (SSA). We examined how quantum and tempo of fertility intentions changed in the first year of COVID-19 and assessed the impact of economic insecurity and sociodemographic characteristics on these changes in SSA. We used longitudinal data collected among 14,053 women from Kenya, Burkina Faso, two provinces in the Democratic Republic of Congo (Kinshasa and Kongo Central), and two states in Nigeria (Kano and Lagos). Descriptive analyses and logistic regression examined overall changes and economic and sociodemographic factors associated with quantum and tempo shifts. At the population-level, most women remained stable in their fertility intentions throughout the first year of COVID-19. Despite widespread income loss, few women reported that COVID-19 influenced their near-term childbearing intentions. However, among women who changed their intentions in Burkina Faso and Kenya, income loss was associated with transitions toward wanting to delay or limit childbearing, particularly among the poorest women. These findings underscore the importance of accounting for context when anticipating the consequences of public health emergencies on fertility.

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Background

The COVID-19 pandemic introduced unprecedented change to the world. Widespread economic crises, food shortages due to supply chain disruptions, and lockdown measures imposed intermittently throughout the pandemic affected the health and livelihood of individuals on a global scale. At the onset of the pandemic, the global family planning community raised alarms about the potential impact of COVID-19 on sexual and reproductive health, including the possibility for significant increases in the number of unintended pregnancies due to reduced childbearing desires in the near-term coupled with disruptions to contraceptive services (Kumar 2020; Cousins 2020; Riley et al. 2020). While recent evidence suggests that increased percentages of women have reported desires to either delay or forgo future pregnancies in the United States and Western Europe (Lindberg et al. 2020; Luppi, Arpino, and Rosina 2020), there remains insufficient evidence on the impact of COVID-19 on women's fertility desires in low- and middle-income countries (LMICs), and particularly in sub-Saharan Africa (SSA).

Findings from the United States and Europe are unlikely to be predictive of fertility behavior in SSA for several reasons. First, the trajectory of the COVID-19 pandemic has varied markedly across settings, as have the economic sequelae. As the pandemic worsened throughout 2020 and into 2021, excess deaths in SSA appeared to remain well below levels seen in other regions of the world (Bamgboye et al. 2021; Nolen 2022) despite rising COVID-19 cases and low vaccination rates, though high-quality estimates of mortality in SSA remain limited (Ioannidis 2021). In conjunction with different epidemiological patterns and changes in viral transmission, restrictions on movement, rapid inflation, and supply chain disruptions led to increases in food prices (Agyei et al. 2021) and declines in food production (Nchanji and Lutomia 2021). Large percentages of households reported income loss and food insecurity in the first waves of the pandemic, with outsize impacts on the poorest and most vulnerable households (Gummerson et al. 2021; Dasgupta and Robinson 2021; Nechifor et al. 2021). While many of these economic insecurities were prevalent worldwide, preexisting poverty in SSA exacerbated these issues. The World Bank estimated that up to 40 million people in Africa were pushed into extreme poverty due to COVID-19 (The World Bank n.d.), with increases in poverty likely to persist (Laborde, Martin, and Vos 2021), though long-term impacts of the pandemic are difficult to predict.

In addition to differences in the trajectory and consequences of the COVID-19 pandemic, pre-COVID-19 contexts differed considerably between high- and low-income settings, particularly related to exposure to the virus and the response to economic and social uncertainty. Existing literature has found that uncertainty—whether arising from economic disruption, epidemics, or other causes—can impact fertility, but the direction and size of the impact differ by context and underlying social and economic

vulnerability. Large-scale economic events, particularly the economic contraction and high unemployment levels, like those associated with the Great Recession, were associated with declines in both fertility intentions and fertility in the United States and Europe (Fahlén and Oláh 2015; Schneider 2015; Comolli 2017). While these reductions were not uniform, with significant variation based on age, parity, education, and socioeconomic disadvantage (Comolli 2017; Goldstein et al. 2013; Schneider and Hastings 2015), the general pattern has been one of postponement and decline, with greater declines among young, nulliparous, and more socioeconomically disadvantaged women. Research in SSA, however, has found that economic uncertainty is frequently accommodated by increased flexibility in timing of fertility intentions, particularly among young women (Trinitapoli and Yeatman 2018), with few declines in the overall number of desired children (Agadjanian 2005). Some research suggests that women who experience food insecurity may have lower childbearing desires (Grace et al. 2017; DiClemente et al. 2021); however, other evidence suggests that food insecurity may lead to accelerated childbearing desires (Sennott and Yeatman 2012), potentially so that women can have children before economic circumstances worsen. Similarly, personal uncertainty related to long-term health and well-being in a context of high HIV transmission has been found to be associated with increases in short-term fertility desires, particularly among young women (Sennott and Yeatman 2012; Hayford, Agadjanian, and Luz 2012). Drawing on lessons learned from other public health emergencies, such as the Zika or Ebola epidemics in Latin America and SSA, respectively, suggests that widespread uncertainty about future health and fears of infection at health facilities are linked to changes in reproductive behaviors and pregnancy preferences (Marteleto et al. 2017; Rangel, Nobles, and Hamoudi 2020; Camara et al. 2017). However, such epidemics may also bear little resemblance to COVID-19's anticipated impact on fertility intentions and practices, particularly in SSA, given differences in mode and timing of viral transmission, risks of mortality and long-term morbidity, and severity of immediate health consequences for reproductive health. While modeled projections of COVID-19's impact on sexual and reproductive health assumed that increased food shortages, poverty, and uncertainty in SSA would lead to widespread declines in desired fertility, previous evidence, though not specific to COVID-19, does not necessarily support this.

In fact, more recent evidence from Zimmerman and colleagues found little change in fertility intentions during the first few months of the COVID-19 pandemic in Kenya (Zimmerman et al. 2022). Rather than delays, increased food insecurity since the onset of the pandemic was associated with accelerating one's desired timing to the next birth, indicating that for vulnerable women, exacerbated resource insecurity may lead to heightened desires to have children sooner (Zimmerman et al. 2022). Using longitudinal data from multiple sites in SSA, Wood and colleagues found limited differences in the proportion of women in need of contraception,

indicating that there were neither large declines in fertility desires nor substantial impacts on contraceptive access (Wood et al. 2021). Data for both studies, however, were collected within the first four months of the COVID-19 pandemic when lockdown measures were most acute. To date, no studies have assessed the longer-term impacts of COVID-19 on fertility intentions, which may evolve as the pandemic persists and continues to affect women's lives and prospects for their futures. The trajectory of the pandemic has fluctuated with the evolution of different variants of SARS-COV-2, and protective measures have been intermittently introduced and relaxed with each wave of the virus. Supply chain challenges have continued to exist, leading to increases in commodity prices, inflation, and food shortages (Agyei et al. 2021; Nchanji and Lutomia 2021; Yu et al. 2021; Nchanji et al. 2021). The impact of the COVID-19 pandemic on fertility intentions may, therefore, shift as women acclimate to living within the pandemic, even as economic sequelae proliferate.

We build on previous research conducted in Kenya in the first four months of the pandemic to understand how COVID-19 affects different pathways of influence—specifically, via individual, partner, and household factors and an individual's sense of economic security—that shape how individuals conceptualize and construct their fertility intentions (Zimmerman et al. 2022). In this analysis, we explore stability and change in fertility intentions over the first year of the pandemic and expand our exploration to six settings in four countries in SSA. We hypothesize that women who experienced economic contraction during the first year of the pandemic will be more likely to report changes in their fertility intentions relative to their prepandemic intentions. We aim to (1) examine how fertility intentions changed in the first year of the COVID-19 pandemic and (2) assess the impact of economic insecurity and sociodemographic characteristics on changes in fertility intentions after one year of living amid the pandemic, including assessing whether the influence of economic insecurity varied by pre-COVID socioeconomic status.

Methods

Study settings and COVID-19

We include data from four countries in SSA: Burkina Faso, the Democratic Republic of Congo (DRC), Kenya, and Nigeria.

Socioeconomic characteristics

Countries included in this study range from 20 million people in Burkina Faso (The World Bank n.d.) to 260 million people in Nigeria, the most populous country in the region (The World Bank n.d.). Burkina Faso and

the DRC, a country of 90 million people (The World Bank n.d.), are Francophone countries in West Africa and Central Africa, respectively, while Kenya and Nigeria are Anglophone countries in East and West Africa, respectively. All four are considered LMICs by international measures. Burkina Faso has a per capita GDP of $857.93 and DRC has a per capita GDP of approximately $543, positioning them at a lower economic level than Kenya and Nigeria, which each has a per capita GDP near $2,000 (The World Bank n.d.). However, Kenya, with a per capita GDP of $1,878, and Nigeria, with a per capita GDP of $2,097, have both witnessed a decline in these measures in recent years (The World Bank n.d.). Apart from the DRC, where approximately three-quarters (77 percent) of the population live on $1.90 or less, the other three countries have comparable poverty rates, reflecting about one-third of their populations experiencing poverty (33.7 percent in Burkina Faso, 37 percent in Kenya, and 39 percent in Nigeria) (The World Bank n.d.).

The most recently available data on the total fertility rate (TFR) in Burkina Faso illustrates little change in recent years. Fertility has decreased slightly from 5.9 children per woman in 2003 to 5.2 children per woman in 2017 and is higher in rural areas (TFR = 5.6) compared to urban areas (TFR = 3.7) (ICF Macro n.d.). Similarly, in the DRC, fertility has remained near 6.5 since 2000 (ICF Macro n.d.) with significant disparities between urban (TFR = 5.4) and rural areas (TFR = 7.3) (Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère de la Santé 2014). Nigeria's TFR declined slightly from 5.7 women in 2003 to 5.3 in 2018, with significant regional variation (National Population Commission (NPC) [Nigeria] and ICF 2019). The TFR in Lagos, which at approximately 15.3 million people is the largest city in SSA (Hoornweg and Pope 2017), is 3.4 versus 6.5 in Kano State, the most populous state in the country (National Population Commission (NPC) [Nigeria] and ICF 2019; Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère de la Santé 2014). In contrast, the TFR in Kenya has declined steadily over the last two decades. Kenya's TFR fell from approximately five children per woman in 1998 to 3.3 in 2020 (ICF Macro n.d.), driven by steady declines in both the rural (TFR: 5.2–3.6, respectively) and urban (TFR: 3.1–2.7, respectively) populations.

As of 2010 in Burkina Faso, roughly one in four women (23.7 percent) reported desires to limit family size and half (50 percent) want to delay having a child for at least two years (Institut National de la Statistique et de la Démographie (INSD) et ICF International 2012). In the DRC, desired family size remains high at approximately six children per woman, but approximately half of women report desires to wait two or more years before their next birth and one in five would like to have no more children (Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère de la Santé 2014). In Kenya, the average

ideal number of children is approximately four per woman and about half of women (48.7 percent) report wanting no more children (ICF Macro n.d.). Despite variation in fertility and fertility intentions by residence, wealth, and education, disparities in fertility and fertility intentions have lessened in recent years in Kenya (ICF Macro n.d.). Nigeria, however, continues to experience large variation between local regions; for example, approximately one-third of women in Lagos reported wanting to limit childbearing in the 2018 DHS, relative to 16 percent of women in Kano (National Population Commission (NPC) [Nigeria] and ICF 2019).

COVID-19 burden and response

The first cases of COVID-19 in each of these countries were detected within a two-week timespan, ranging from February 27, 2020, in Nigeria (Adebowale et al. 2021) to March 10, 2020, in the DRC (WHO Africa n.d.). As of April 19, 2022, the total number of confirmed cases ranged from 324,000 in Kenya, with 5,649 deaths, to 20,865 cases in Burkina Faso with 383 deaths (Global Change Data Lab n.d.). It is likely that case counts and deaths are substantially underestimated due to shortage in testing and inadequate systems for tracking the virus (Ioannidis 2021) and that COVID-19 has been widely transmitted (Chechet et al. 2021; Moser et al. 2021; Cohen et al. 2022). However, despite widespread transmission, evidence suggests total deaths due to COVID-19 are substantially lower in SSA than other regions (Bamgboye et al. 2021; Nolen 2022; Wamai et al. 2021).

All countries swiftly responded to the onset of COVID-19 by imposing nationwide restrictions to curb the spread of infection: closure of educational institutions, lockdowns on nonessential activities, night curfews, and limits on intra- and interregional travel were implemented in all countries (Nechifor et al. 2021; Jacobs and Okeke 2022; Ozer et al. 2022). The four nations differed regarding other health and humanitarian factors present in their countries, which impacted the government's capacity to respond to COVID-19. With the most robust pandemic response capacity, Kenya carried out the most comprehensive response. In addition to government lockdown restrictions and education campaigns to encourage preventive behavior, the Kenyan ministry of health deployed surveillance systems and diagnostic protocols, facilitating early detection and contact tracing [48]. Similarly, the Nigeria Centre for Disease Control led the COVID-19 response in Nigeria, with support and oversight from a task force established by the president shortly after the first case was confirmed in March 2020. Contact tracing was relatively minimal, as it required manual follow-up and no digital tracing campaigns were created (Jacobs and Okeke 2022). Testing capacity was limited, resulting in only a small fraction of the population being tested throughout the pandemic (Jacobs and Okeke 2022). Lockdowns were lifted in stages between June and October of 2020 (Presidential Task

Force on COVID-19 and Office of the Secretary to the Government of the Federation 2020).

In contrast, Burkina Faso and the DRC developed and implemented their responses to the pandemic within the context of compounding crises. Amid high rates of violence, displacement, and limited health services in 2020, Burkina Faso's response to COVID-19 was achieved with ample financial and administrative support from the international community (Human Rights Watch 2020; UN Foundation 2020). A State of Health Alert was issued in March 2020 through May 5 that imposed significant travel restrictions, including city-wide lockdowns in the event of a positive COVID-19 case (Ozer et al. 2022). When the DRC confirmed its first case of COVID-19 on March 10, 2020, the country was continuing to battle the North Kivu Ebola epidemic that began in 2018 and was declared over in June 2020 (Africa CDC n.d.). It was hoped that extensive experience responding to Ebola epidemics over the last decade would facilitate an effective response to COVID-19 (United Nations 2020); however, insufficient testing, lack of personal protective equipment, and a shortage of health workers, many of whom were simultaneously responding to the Ebola epidemic, hindered response efforts (Juma et al. 2020).

Although all LMICs struggled to secure vaccine doses early on in the pandemic, by 2021, most African countries managed to secure vaccine doses through the WHO's ACT-Accelerator ("The Access to COVID-19 Tools (ACT) Accelerator" n.d.). Despite persistent humanitarian challenges, as of April 2022, Burkina Faso has vaccinated about 10 percent of its population (Reuters n.d.). Kenya and Nigeria have administered at least one dose to about 22 percent and 11 percent of their populations, respectively (*Reuters* n.d.). Vaccine hesitancy has posed an additional barrier to increasing vaccination levels throughout the region but is especially challenging in the DRC (Ditekemena et al. 2021). Since April 19, 2021, the nation has been vaccinating its residents, but nearly one year later only a total of 881,240 vaccine doses have been administered, enough to cover less than 1 percent of the population (Reuters n.d.).

While overall mortality and morbidity related to COVID-19 appear to be lower in SSA, the economic fallout from the pandemic has been devastating, with significant income loss resulting from the mobility restrictions detailed above (Béné 2020). Poverty and food insecurity in SSA increased drastically as a result of COVID-19; almost 150 million people were projected to fall into extreme poverty and experience food insecurity (Laborde, Martin, and Vos 2021). Kenya experienced a decline in average GDP, resulting in overall declines in food consumption (Nechifor et al. 2021). These effects were somewhat offset by a robust government response to regulate commodity prices and support domestic production (Nechifor et al. 2021); however, food insecurity was as high as 58 percent in rural areas in mid-2020 before recovering over time (Tabe-Ojong et al. 2022). Early evidence

indicates that food insecurity increased throughout Nigeria shortly after the onset of the pandemic, and declined over time, with disproportionate impacts on lower-income households (Tabe-Ojong et al. 2022). Job losses and inflation in the DRC have led to increased poverty and food insecurity (Batana, Jarotschkin, and Viboudoulou Vilpoux n.d.), and 85 percent of households in Kinshasa reported a reduction in food consumption; however, evidence seemed to indicate losses were similar across wealth gradients (Gummerson et al. 2021). In Burkina Faso, 2.6 million people are expected to face food insecurity in 2022 (World Food Program USA n.d.), which, combined with ongoing civil conflict, necessitates significant humanitarian assistance and ongoing emergency response (Ozer et al. 2022). Early evidence suggests that while income loss and food insecurity were widespread in Burkina Faso during the first stages of the pandemic, impacts were worse in urban, relative to rural, areas (Gummerson et al. 2021). It is within these contexts of high desired fertility and high poverty, coupled with challenging social, health, and economic circumstances, that we aimed to study how women changed their fertility intentions amid the first year of the COVID-19 pandemic and identify what factors shaped these changes.

Datasets

This analysis used longitudinal data collected as part of the Performance Monitoring for Action (PMA) project, among women aged 15–49 in six settings across four countries: Kenya, Burkina Faso, two provinces in DRC (Kinshasa and Kongo Central), and two states in Nigeria (Kano and Lagos). PMA employed multistage cluster sampling in each geography, first selecting enumeration areas (EAs) using stratified random sampling with probability proportional to size. All households within each EA were listed, and 35 households were randomly selected for interview. All women between the ages of 15–49 who usually lived within the household or who slept in the household the night before were eligible for interview. Eligible women were approached for consent, and informed consent was delivered by trained interviews. Oral versus written consent, in addition to the need for parental consent and adolescent assent, was determined based on each country's relevant ethical review board, listed below.

Baseline data (termed "Phase 1" in PMA) were collected between November 2019 and February 2020, before the onset of the COVID-19 pandemic, among 22,264 women across the six settings (Table 1). Of these baseline women, 18,180 were reinterviewed at follow-up (termed "Phase 2" in PMA) between November 2020 and February 2021. Attrition rates ranged from 2.6 percent in Burkina Faso to 19.5 percent in Kenya, with final samples including 78.7 percent to 92.3 percent of eligible women in the baseline samples. Baseline and follow-up surveys asked women about their sociodemographic characteristics, health behaviors, reproductive

TABLE 1 Survey collection dates, sample sizes, and response rates, by geography

	Baseline data collection dates	Follow-up data collection dates	Eligible baseline sample (*N*)	Loss to follow-up (%)	Completed follow-up (*N*)	Response rate among baseline sample (%)	Response rate among contacted women (%)
Burkina Faso	Dec. 2019–Feb. 2020	Dec. 2020–Mar. 2021	6,532	2.6	5,491	84.1	99.7
Kinshasa, DRC	Dec. 2019–Feb. 2020	Nov. 2020–Feb. 2021	2,549	17.8	2,006	78.7	95.8
Kongo Central, DRC	Dec. 2019–Feb. 2020	Nov. 2020–Feb. 2021	1,902	18.0	1,534	80.7	98.5
Kenya	Nov.–Dec. 2019	Nov.–Dec. 2020	8,797	19.5	7,018	79.8	99.1
Kano, Nigeria	Nov.–Dec. 2019	Dec. 2020–Feb. 2021	1,085	7.4	1,001	92.3	99.7
Lagos, Nigeria	Nov.–Dec. 2019	Dec. 2020–Feb. 2021	1,399	16.0	1,130	80.8	96.7

NOTE: Data reflect a full eligible sample of women for the nationally or regionally representative surveys. Sample sizes and response rates not restricted to only women eligible for analysis presented in this paper.

intentions and practices (e.g., fertility intentions, contraceptive use), economic circumstances, and changes in fertility intentions related to the COVID-19 pandemic.

Ethical approval for PMA's data collection activities, resulting in baseline (Phase 1) and follow-up (Phase 2) data used for this analysis, was provided by in-country ethical review boards, including the Ethics Committee for Health Research at the Ministry of Health and Ministry of Higher Education, Scientific Research and Innovation in Burkina Faso; the University Of Kinshasa School of Public Health in DRC; the Kenya Medical Research Institute (KEMRI) Ethics Review Committee in Kenya; and the Lagos State University Teaching Hospital Research Ethics Committee and the Kano State Health Research Ethics Committee of the Ministry of Health and the Research Ethics Committee of the Aminu Kano Teaching Hospital in Nigeria.

Analytic samples

We restricted analyses to women aged 15–49 who self-reported being sexually active (defined as ever having had sex) and fecund at baseline and follow-up. Given our focus on understanding changes in fertility intentions among all women in the context of COVID-19, including women who were currently or recently pregnant, we included women who were pregnant at baseline or follow-up. Finally, we included only complete cases (i.e., women who were not missing any information for either outcome or adjustment variables), as missingness was very low (<3 percent) for these variables in our sample.

We use two analytic samples for analyses. First, we use longitudinal data from all six geographies to explore women's trajectories of fertility intentions and pregnancy status during the first year of the COVID-19 pandemic. This included baseline and follow-up data collected among 14,053 women across the six geographies (4,502 women in Burkina Faso; 1,462 in Kinshasa, DRC; 949 in Kongo Central, DRC; 5,727 in Kenya; 949 in Kano, Nigeria; and 851 in Lagos, Nigeria). Second, due to sample size restrictions in other geographies, we use longitudinal data from Kenya and Burkina Faso to explore correlates of individual-level changes in fertility intentions, totaling 7,189 women in the two countries.

Measures

Our primary dependent variable was change in fertility intentions during the first year of the COVID-19 pandemic, which we explored in two ways. First, we defined a four-category variable based on fertility intention and reproductive status at baseline: pregnant, wants another child within two years, wants another child in two or more years, or wants no more children. As our intention was to explore consistency in desired timing of next birth,

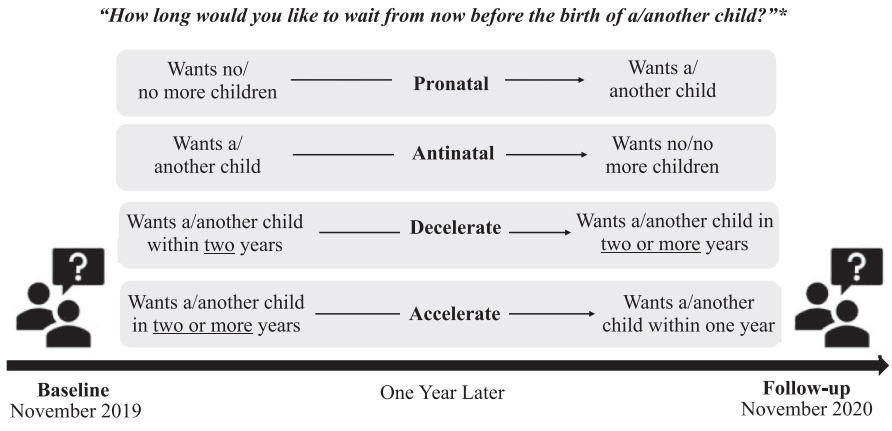
our outcome variable at follow-up accounted for a one-year passage of time; that is, at follow-up women were categorized as pregnant, wants another child within one year, wants another child in one or more years, or wants no more children.

Next, we defined measures of individual change in fertility intentions between baseline and follow-up. We first defined the change in desire to have any/any more children as a change in *quantum*. At each interview, nonpregnant women were asked, "Would you like to have a/another child or would you prefer not to have any/any more children?"; whereas pregnant women were asked, "After the birth of the child you are expecting now, would you like to have a/another child or would you prefer not to have any more children?" We combined women's responses into one variable at each time point, which indicated whether the woman wanted another child in the future, regardless of her current pregnancy status. Women who switched from not wanting any/more children at baseline to wanting any/more children at follow-up were categorized as *pronatal* while those who stated that they want more children at baseline but switched to not wanting more children at follow-up were categorized as *antinatal*.

We then examined changes in desired timing to the next birth, which we defined as a change in *tempo*, among women who stated at baseline that they would like another child. At each interview, nonpregnant women who wanted a/another child were asked, "How long would you like to wait from now before the birth of a/another child?", while pregnant women who wanted a/another child were asked, "After the birth of the child you are expecting now, how long would you like to wait before the birth of another child?" Again, we combined women's responses to these questions into one variable, indicating their preferred timing to next birth. We compared fertility intentions in the next two years at baseline to fertility intentions in the next year at the follow-up to account for the one-year time lapse between surveys; we identified *decelerators* as women who wanted a/another child within two years at baseline but wanted to wait more than a year to have a/another child at follow-up. Conversely, *accelerators* were defined as women who wanted to wait more than two years at baseline but indicated wanting a child within one year at follow-up (Figure 1). The population of women categorized as *accelerators* reflects those who expressed plans to have children sooner when they were asked about their fertility intentions later in the pandemic, while those categorized as *decelerators* reflect those who indicated plans to wait for a longer period (within a one-year timeframe) to have a/another child. We did not explore shifts in longer-term fertility intentions, that is, shifts in desired timing that occurred past the two-year time frame, as our aim was to explore the impact of COVID-19 on more immediate fertility intentions.

Our primary independent variables were related to economic hardship experienced during the COVID-19 pandemic collected at follow-up.

FIGURE 1 Categorization of women's changes in fertility intentions during the first year of the COVID-19 pandemic



*Among pregnant women, this question was: "After the birth of the child you are expecting now, how long would you like to wait before the birth of another child?"

To capture economic instability during the pandemic, we examined food insecurity in the past four weeks and household income loss in the last year. We measured household income loss by asking women, "During the last 12 months, how much of a loss of income did your household experience?" (none, partial, complete). We assessed food insecurity by asking, "During the past 4 weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?" (yes/no).

We also included potential sociodemographic factors that may confound the relationship of economic instability on women's change in fertility intentions, as suggested in previous studies (Trinitapoli and Yeatman 2018; Sennott and Yeatman 2012; Zimmerman et al. 2022). Sociodemographic characteristics included residence (urban/rural), parity (0–2, 3–4, 5+ children), age (15–24, 25–34, 35–49 years), marital status (married or living together/not), and wealth tertile (lowest, middle, highest) as measured at baseline. While age has been identified as a relevant predictor, due to multicollinearity with parity, we excluded age from nondescriptive analyses. We defined a binary variable indicating the highest level of education that the respondent had attended. Due to differences in levels of education between Kenya and Burkina Faso, we categorized women as having "no education" (lower) versus "any education" (higher) in Burkina Faso, while in Kenya, we categorized women as having "no education or primary education" (lower) versus "post-primary education" (higher). Finally, as experience of a recent pregnancy has been shown to be strongly associated with a change in fertility intentions (Sennott and Yeatman 2012; Ní Bhrolcháin, Beaujouan, and Berrington 2010), we also defined a variable assessing

pregnancy experience during the survey period (pregnant at baseline; pregnant by follow-up, including during the interim survey period but not at follow-up; and not pregnant any time between baseline and follow-up, using no pregnancy as the reference). A very small number of women were pregnant at both time points and were included as pregnant at baseline.

Analysis

For the descriptive analysis, we used Sankey diagrams to illustrate women's changes in fertility intentions between baseline and follow-up. Specifically, we calculated the weighted proportions of women at baseline who were pregnant, wanted children within two years, wanted children in two or more years, and those who wanted no/no more children. Similarly, at follow-up, we calculated the weighted proportions of women who were pregnant, wanted children within one year, wanted children in one or more years, and those who wanted no/no more children. Though not included in the Sankeys, we also include population-level estimates of the percent of women who stated that they changed their mind about becoming pregnant due to COVID-19.

In individual analyses, we explored bivariate associations between sociodemographic and COVID-19-related factors and women's change to pronatal, antinatal, decelerated, or accelerated fertility intentions between baseline and follow-up. Finally, we constructed four multivariate logistic regression models to explore correlates of changes in women's *quantum* and *temporal* fertility intentions between baseline and follow-up, specifically: (1) among women who wanted no/no more children at baseline, the odds of switching to *pronatal* (want a/any children) one-year later; (2) among women who wanted a/any more children at baseline, the odds of switching to *antinatal* (want no/no more children) one-year later; (3) among women who wanted children within two years at baseline, the odds of *decelerating* to wanting a/another child in one or more years at follow-up, and (4) among women who wanted children in more than two years at baseline, the odds of *accelerating* to wanting a/another child within one year at follow-up. We note that, for shifts in both quantum and tempo, we examined women's fertility *intentions*, not outcomes like pregnancies or births. Thus, women who were pregnant during the intersurvey period were classified not based on whether they experienced a pregnancy or birth, but only on their reported prospective intentions at each interview. Instead, we accounted for the role of recent pregnancy and birth experiences by including the indicator of recent pregnancy in our analytic models.

Multivariate regression models adjusted for all sociodemographic and COVID-19-related factors. No women in Burkina Faso reported that they lived in a home with no income loss in the previous year, thus in our regression analyses for Burkina Faso, income loss was operationalized as a

binary variable indicating either partial or complete income loss, while in Kenya, the variable was categorical indicating no income loss, partial, or complete loss. Within each model, we also tested for an interaction between household wealth at baseline and household income loss in the last year at follow-up to examine if the impact of household income loss differed by wealth levels. Interaction terms were largely insignificant, with the exception of one model. As few women who were currently pregnant at baseline reported wanting another child in less than two years, we were unable to include this variable in the exploration related to decelerating timing. We conducted a sensitivity analysis to explore if the association between economic shocks and fertility intentions was moderated by a woman's stage of her reproductive life course (lower vs. higher number of children, reflecting transitions toward achieving desired fertility) by testing interaction terms between parity and wealth, as well as parity and income loss. No interactions were significant.

All analyses accounted for the complex survey design and attrition between baseline and follow-up. Baseline survey weights accounted for multistage sampling and differential probability of selection. Baseline weights were adjusted using inverse propensity scores; more specifically, we estimated propensity scores for being lost-to-follow-up based on select sociodemographic characteristics and applied the inverse score to the original baseline weight to account for differential loss-to-follow-up. Additional information on the survey design and weight construction is available at https://www.pmadata.org/data/survey-methodology. Additional details about the sampling design, questionnaires, and survey are available at www.pmadata.org.

Results

Descriptive

Table 2 presents the characteristics of women in our sample in each setting. In Burkina Faso, Kenya, and Kano, most women lived in rural areas, while all women in Lagos and Kinshasa resided in urban settings. Residential data were unavailable for Kongo Central, as the statistics agency in DRC does not stratify by urban/rural residence. Educational attainment varied widely across geographies, with more than half of women in Burkina Faso never attending school (62.6 percent) relative to the vast majority of women in Kinshasa who attended post-primary school (equivalent to secondary education) or higher (92.2 percent). About one-third of women in each setting were aged 25–34 years, with women in Kinshasa and Kongo Central, DRC slightly younger, on average, than women in other geographies. Roughly one-quarter of women in each setting had —three to four children at baseline, and, while most women were not pregnant at any point during the

TABLE 2 Characteristics of sexually active, fecund women who completed baseline and follow-up surveys, by geography

	Burkina Faso		Kinshasa, DRC		Kongo Central, DRC		Kenya		Kano, Nigeria		Lagos, Nigeria	
	(N = 4,439)		(N = 1,552)		(N = 1,014)		(N = 5,869)		(N = 657)		(N = 858)	
	n	%	n	%	N	%	n	%	n	%	n	%
Sociodemographic factors												
Residence												
Urban	2,469	20.9	-	-	-	-	1,768	30.8	218	36.4	851	100.0
Rural	1,970	79.1	-	-	-	-	3,981	69.3	380	63.6	-	0.0
Education												
None	2,136	62.6	4	0.2	97	10.2	283	4.9	310	51.9	15	1.8
Primary+	2,301	37.4	114	7.6	239	26.1	2,615	45.5	118	19.8	93	10.8
Post-primary or higher	-	0.0	1,434	92.2	675	63.7	2,852	49.6	169	28.3	750	87.4
Age (years)												
15–24	1,600	35.2	593	38.3	373	38.3	2,022	33.2	210	35.2	164	19.0
25–34	1,616	35.5	532	34.3	368	37.8	2,034	35.3	238	39.8	321	37.3
35–49	1,332	29.3	425	27.4	232	23.9	1,813	31.5	149	25.0	376	43.7
Parity												
0–2	2,104	46.3	1,080	69.7	545	56.0	3,123	54.3	231	38.7	523	60.7
3–4	1,101	24.2	308	19.9	249	25.6	1,473	25.6	128	21.4	258	29.9
5 or more	1,343	29.5	162	10.5	179	18.4	1,154	20.1	238	39.9	81	9.4
Recent pregnancy status												
Pregnant at baseline	409	10.2	107	6.5	117	11.8	370	6.4	83	13.9	52	6.1
Pregnant between baseline and follow-up	744	18.7	209	13.2	247	26.2	898	15.6	207	34.6	89	10.3

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TABLE 2 (Continued)

	Burkina Faso		Kinshasa, DRC		Kongo Central, DRC		Kenya		Kano, Nigeria		Lagos, Nigeria	
	(N = 4,439)		(N = 1,552)		(N = 1,014)		(N = 5,869)		(N = 657)		(N = 858)	
	n	%	n	%	N	%	n	%	n	%	n	%
Not pregnant during survey period	3,286	71.0	1,236	80.2	650	62.0	4,482	78.0	307	51.5	720	83.6
Marital status												
Not married/in union	976	16.0	800	52.9	353	34.0	1,963	34.1	46	7.8	261	30.3
Married/In union	3,463	84.0	752	47.1	661	66.0	3,787	65.9	551	92.2	601	69.7
Wealth												
Low	856	34.3	536.2	34.9	313	32.2	2,033	35.4	204	34.2	292	33.9
Middle	1,022	33.5	504.5	32.84	321	33.0	1,992	34.7	199	33.3	304	35.3
High	2,560	32.2	495.7	32.26	339	34.8	1,724	30.0	194	32.5	265	30.8
COVID-19-related factors												
Household income loss												
Complete	473	10.0	650	42.6	192	17.7	1,465	25.5	77	12.9	292	33.9
Partial	3,959	90.0	902	57.4	817	81.9	3,151	54.8	520	87.1	567	65.8
None	-	0.0	-	0.0	-	0.0	1,132	19.7	-	0.0	-	0.0
Food insecurity in last 4 weeks												
No	4,211	93.8	1,228	80.1	857	85.6	5,119	89.1	554	92.8	799	92.8
Yes	227	6.2	324	19.9	155	14.4	630	11.0	43	7.2	62	7.2

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TABLE 2 (Continued)

	Burkina Faso		Kinshasa, DRC		Kongo Central, DRC		Kenya		Kano, Nigeria		Lagos, Nigeria	
	(N = 4,439)		(N = 1,552)		(N = 1,014)		(N = 5,869)		(N = 657)		(N = 858)	
	n	%	n	%	N	%	n	%	n	%	n	%
Outcomes												
Change in fertility intentions												
Pronatal	162	3.6	78	5.0	84	8.6	411	7.1	35	5.9	40	4.6
Antinatal	192	4.2	96	6.2	90	9.2	401	7.0	35	5.8	55	6.4
Decelerator	571	12.6	152	9.8	47	4.8	351	6.1	88	14.8	79	9.1
Accelerator	280	6.2	62	4.0	24	2.5	138	2.4	54	9.1	41	4.7
Changed mind about wanting to get pregnant due to COVID-19												
No	3,686	89.7	1,412	97.6	838	96.0	5,115	94.5	499	94.5	781	95.4
Yes	424	10.3	34	2.4	34	3.9	296	5.5	29	5.5	35	4.2

NOTE: Weighted column totals (*n*) and proportions (%). +In Burkina Faso, category of "Primary" education reflects any schooling.

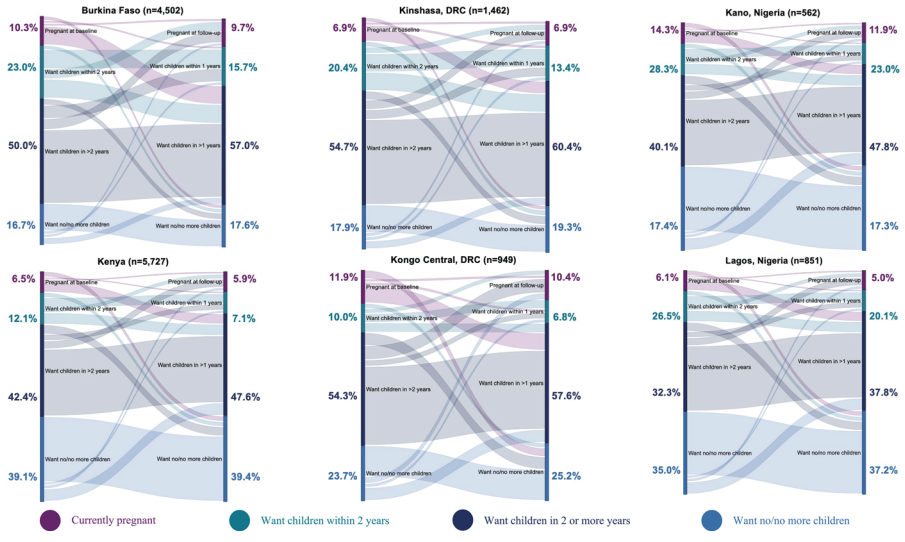
survey period (from 51.5 percent of women in Kano to 83.6 percent of women in Lagos), at least 6.0 percent of women in each setting were pregnant at baseline, with this proportion rising to 13.9 percent of women in Kano. Most women across geographies were married or in-union, with the exception of Kinshasa where more than half of women were not married or partnered.

The economic impact of COVID-19 on household income loss in the past 12 months was widespread, with nearly all women across geographies reporting at least partial income loss. Nearly half of women in Kinshasa indicated their households experienced complete income loss, while this was true for 12.9 percent of women in Kano. Kenya was the only setting where some women (19.7 percent) reported experiencing no household income loss in the past 12 months. Food insecurity in the past four weeks ranged from 6.2 percent to 7.2 percent in Burkina Faso, Kano, and Lagos and was most common in Kinshasa, where one in five women (19.9 percent) reported that a household member went a whole day and night without eating.

Women's fertility intentions in the first year of the pandemic varied considerably across geographies between baseline and follow-up. Quantum changes in fertility intentions were most common in Kongo Central and least common in Burkina Faso. The proportion of women classified as pronatal—or switching from wanting no/no more children at baseline to wanting a/another child at follow-up—ranged from 3.6 percent in Burkina Faso to 8.6 percent in Kongo Central. Similarly, the proportion of women classified as antinatal—or switching from wanting a/another child at baseline to wanting no/no more children at follow-up—ranged from 4.2 percent in Burkina Faso to 9.2 percent in Kongo Central. Temporal changes in fertility intentions were infrequent, and deceleration was more common than acceleration of desired time to next birth. The proportion of women categorized as decelerators—or those who postponed their desired timing of next birth when asked at follow-up—ranged from 4.8 percent in Kongo Central to 14.8 percent in Kano. Fewer women reported that they wanted children sooner than their desired timing at baseline: a response shared by 2.4 percent of women in Kenya and rising to 6.2 percent of women in Burkina Faso. Roughly one in 10 women in Burkina Faso reported changing their mind about wanting to get pregnant due to COVID-19, while this was the case for 2.4–5.5 percent of women across the other geographies.

The Sankey diagrams in Figure 2 show changes in women's fertility intentions during the first year of the COVID-19 pandemic in each setting. The left panel in each setting shows the distribution of women reporting each of the fertility intentions and pregnancy status at baseline, while the right panel shows these distributions at follow-up. Across nearly all settings, the largest percentage of women wanted a child, but wished to delay for more than two years (reflected in the dark blue ribbons), ranging from

FIGURE 2 Sankey diagrams of changes in women's fertility intentions during the first year of COVID-19, by geography



40.1 percent in Kano, Nigeria to 54.7 percent in Kinshasa, DRC at baseline and rising to 47.6 percent in Kenya and 60.4 percent in Kinshasa, DRC at follow-up). The only exception to this trend was among women in Lagos, Nigeria, where the largest proportion of women at baseline reported wanting no/no more children (35.0 percent), followed by about one-third (32.3 percent) of whom wanted a child in more than two years; at follow-up these proportions each rose to greater than 37.0 percent, indicating a shift toward delaying or stopping childbearing altogether. Across all settings, most women who were pregnant at baseline shifted to wanting another child in at least one year, with very few reporting that they wanted a child in less than one year. Finally, we note that across all geographies, approximately similar percentage of women shifted from wanting no/no more children to wanting children as vice versa. On the whole, these figures demonstrate both a lack of large-scale shifts in fertility intention at the population-level toward greater desire to postpone and limit childbearing and the considerable variability in intentions at the individual level.

Logistic regression

Quantum changes in fertility intentions. Table 3 shows the adjusted odds ratios of adopting pronatal intentions (i.e., among women who stated they wanted no/no more children at baseline, reporting they wanted a/another child at follow-up) and antinatal intentions (i.e., among women who stated they wanted a/another child at baseline, reporting they wanted no/no more children at follow-up).

TABLE 3 Adopting pronatal or antinatal childbearing intentions between baseline and follow-up (reference: stable)

	Burkina Faso								Kenya							
	Pronatal[a] (n = 759)				Antinatal[b] (n = 3,633)				Pronatal[a] (n = 2,597)				Antinatal[b] (n = 3,245)			
	AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI	
Sociodemographic																
Residence																
Urban	ref				ref				ref				ref			
Rural	1.28	0.379	0.73	2.24	0.78	0.402	0.44	1.40	1.21	0.284	0.85	1.70	0.93	0.680	0.68	1.29
Educationc																
Lower	ref				ref				ref				ref			
Higher	1.01	0.962	0.59	1.75	0.88	0.669	0.47	1.62	1.16	0.308	0.87	1.55	0.75	0.064	0.55	1.02
Parity																
0-2	ref				ref				ref				ref			
3 or more	**0.07**	**<0.001**	**0.03**	**0.20**	**9.32**	**<0.001**	**3.95**	**22.00**	**0.20**	**<0.001**	**0.14**	**0.27**	**3.19**	**<0.001**	**2.37**	**4.30**
Recent pregnancy status																
Not pregnant during survey period	ref				ref				ref				ref			
Pregnant at baseline	2.04	0.124	0.82	5.09	0.60	0.222	0.26	1.37	**1.88**	**0.010**	**1.16**	**3.02**	0.93	0.799	0.55	1.59
Pregnant between baseline and follow-up	0.42	0.090	0.16	1.15	**1.64**	**0.048**	**1.00**	**2.69**	**2.03**	**0.001**	**1.36**	**3.05**	**1.78**	**0.001**	**1.28**	**2.46**
Marital status																
Not married	ref				ref				ref				ref			

/...

TABLE 3 (Continued)

	Burkina Faso								Kenya							
	Pronatal[a] ($n = 759$)				Antinatal[b] ($n = 3,633$)				Pronatal[a] ($n = 2,597$)				Antinatal[b] ($n = 3,245$)			
	AOR	*p*-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI	
Married/In union	1.25	0.624	0.50	3.12	0.68	0.478	0.23	2.01	1.11	0.497	0.82	1.52	**1.78**	**0.002**	**1.25**	**2.55**
Wealth																
Lowest	ref				ref				ref				ref			
Middle	1.06	0.831	0.60	1.89	1.40	0.347	0.69	2.84	0.91	0.565	0.67	1.24	1.30	0.098	0.95	1.79
Highest	0.78	0.412	0.42	1.42	1.36	0.401	0.66	2.79	0.81	0.306	0.53	1.22	1.19	0.379	0.80	1.77
COVID-19-related factors																
Household income loss																
None	-	-	-	-	-	-	-	-	ref				ref			
Partial	ref				ref				1.02	0.893	0.72	1.45	1.19	0.350	0.82	1.73
Complete	1.07	0.877	0.45	2.56	1.11	0.769	0.55	2.26	0.98	0.920	0.65	1.48	**1.59**	**0.035**	**1.03**	**2.43**
Food insecurity in last four weeks																
No	ref				ref				ref				ref			
Yes	0.42	0.087	0.16	1.14	1.46	0.470	0.52	4.09	0.88	0.525	0.59	1.31	0.95	0.824	0.60	1.51

NOTE: Values in bold indicate statistical significance at $p < 0.05$.[a]Odds of shifting to pronatal fertility intentions explored only among women who reported wanting no more/no children at baseline.[b]Odds of shifting to antinatal fertility intentions explored only among women who reported wanting any/more children at baseline.[c]Highest educational attainment differed by geography due to distributions: in Burkina Faso, lower = no schooling, higher = any schooling; in Kenya, lower = none/primary; higher = post-primary.

Neither wealth at baseline, income loss in the past 12 months, or experience of food insecurity in the past four weeks was associated with adopting pronatal intentions in either setting. Complete income loss increased the odds of adopting antinatal intentions in Kenya (adjusted odds ratio: 1.59, 95 percent confidence interval: 1.03–2.43) but had no association in Burkina Faso. Parity and recency of last pregnancy were inversely related to adopting pronatal intentions and positively related to adopting antinatal intentions in both settings. In both countries, relative to women who were not pregnant during the survey period, women who became pregnant between baseline and follow-up were significantly more likely to report antinatal intentions. In Kenya, women who were pregnant at any point in the survey (i.e., pregnant at baseline, follow-up, or between the two surveys) were also more likely to adopt pronatal intentions. Finally, in Kenya, married women were significantly more likely to adopt antinatal intentions than women who were unmarried, while women with at least some post-primary education had moderately lower odds of adopting antinatal intentions relative to women with primary school or no education.

Tempo changes in fertility intentions. Table 4 shows the adjusted odds ratios of decelerating fertility intentions (i.e., among women who stated they wanted a child in less than two years at baseline, reporting at follow-up they wanted a child in one or more years) and of accelerating fertility intentions (i.e., among women who stated they wanted another child in two or more years at baseline, reporting at follow-up that they wanted a child in less than one year).

In both countries, economic variables appeared to significantly affect the desire to delay an upcoming birth, but not to accelerate timing to next birth. Specifically, in Burkina Faso, women in the poorest households who experienced complete income loss were significantly less likely to report delayed intentions relative to those with partial income loss (aOR: 0.16, 95 percent CI: 0.04–0.67). Results of the interaction term showed that the effect of complete income loss differed significantly between women in the poorest and wealthiest households (aOR: 4.83, 95 percent CI: 1.24–18.78); among women in the wealthiest households, there was no difference in the odds of decelerating fertility intentions based on partial or complete income loss (aOR: 0.16 $\times$ aOR: 4.83 $=$ 0.77). In Kenya, while income loss and food insecurity experienced during COVID-19 were not significantly related to decelerating, wealthier women at baseline, and specifically those in the middle tertile, had significantly lower odds of decelerating their fertility intentions than women in the poorest tertile (aOR: 0.50, 95 percent CI: 0.30–0.83). In both sites, women who experienced a pregnancy during the survey period were significantly less likely to accelerate their fertility intentions than women who were not pregnant during the survey period. In Burkina Faso, increasing parity and being married or in-union were both

TABLE 4 Acceleration and delay of fertility intentions among women who wanted children before and during COVID-19 (reference: stable)

	Burkina Faso								Kenya							
	Accelerate[a] (*n* = 2,371)				Delay[b] (n = 1,081)				Accelerate[a] (*n* = 2,229)				Delay[b] (*n* = 601)			
	AOR	p-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI	
Sociodemographic																
Residence																
Urban	ref				ref				ref				ref			
Rural	1.19	0.459	0.75	1.89	1.37	0.171	0.87	2.15	0.67	0.103	0.42	1.08	1.30	0.340	0.75	2.26
Education[c]																
Lower	ref				ref				ref				ref			
Higher	1.06	0.783	0.70	1.62	1.33	0.239	0.83	2.13	0.89	0.587	0.57	1.37	**1.57**	**0.023**	**1.07**	**2.33**
Parity																
0–2	ref				ref				ref				ref			
3+	1.06	0.797	0.69	1.62	0.69	0.052	0.47	1.00	0.98	0.939	0.58	1.67	1.33	0.317	0.76	2.31
Recent pregnancy status																
Not pregnant during survey period	ref								ref							
Pregnant at baseline	**0.18**	**<0.001**	**0.09**	**0.37**					**0.28**	**0.002**	**0.12**	**0.62**				
Pregnant between baseline and follow-up	**0.04**	**0.001**	**0.01**	**0.26**					**0.19**	**<0.001**	**0.10**	**0.38**				
Marital status																
Not married	ref				ref				ref				ref			

/...

TABLE 4 (Continued)

	Burkina Faso								Kenya							
	Accelerate[a] (*n* = 2,371)				Delay[b] (n = 1,081)				Accelerate[a] (*n* = 2,229)				Delay[b] (*n* = 601)			
	AOR	p-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI		AOR	*p*-value	95% CI	
Married/In union	1.28	0.381	0.74	2.22	0.75	0.164	0.49	1.13	**2.98**	**<0.001**	**1.76**	**5.06**	1.21	0.387	0.78	1.89
Wealth																
Lowest	ref				ref				ref				ref			
Middle	0.85	0.566	0.50	1.47	1.35	0.283	0.78	2.35	1.02	0.926	0.64	1.63	**0.50**	**0.007**	**0.30**	**0.83**
Highest	1.28	0.406	0.72	2.27	**0.49**	**0.037**	**0.25**	**0.96**	0.97	0.922	0.54	1.76	0.53	0.084	0.26	1.09
COVID-19-related factors																
Household income loss																
None	-	-	-	-	-	-	-	-	ref				ref			
Partial	ref				ref				1.12	0.666	0.67	1.86	1.11	0.676	0.68	1.83
Complete	1.75	0.122	0.86	3.58	**0.16**	**0.012**	**0.04**	**0.67**	1.07	0.840	0.57	1.99	0.93	0.822	0.51	1.71
Food insecurity in last 4 weeks																
No	ref				ref				ref				ref			
Yes	0.76	0.436	0.38	1.52	1.44	0.319	0.70	2.98	1.14	0.750	0.51	2.56	1.06	0.854	0.54	2.08
Interaction: Wealth × Income loss																
Lowest wealth × Partial					ref											
Middle wealth × Complete					1.24	0.866	0.10	15.68								
Highest tertile × Complete					**4.83**	**0.023**	**1.24**	**18.78**								

NOTE: Values in bold indicate statistical significance at $p < 0.05$.[a]Odds of accelerating fertility intentions explored only among women who reported wanting children in more than one year at baseline.[b]Odds of delaying fertility intentions explored only among women who reported wanting children within one year at baseline.[c]Highest educational attainment differed by geography due to distributions: in Burkina Faso, lower = no schooling, higher = any schooling; in Kenya, lower = none/primary; higher = post-primary.

marginally associated with decreased odds of wanting to delay childbearing, while marital status was significantly associated with accelerating desired time to next birth in Kenya. Finally, in Kenya, women with post-primary education or higher were significantly more likely to decelerate their fertility intentions compared to women who were less educated.

Discussion

Our longitudinal study exploring changes in women's fertility intentions during the first year of the COVID-19 pandemic in six SSA geographies finds modest evidence of the pandemic's economic impact on women's desired timing and number of children. Despite widespread income loss during this period, few women in our study reported that COVID-19 influenced their childbearing intentions for the near future, consistent with population-level trends demonstrating that most women's fertility intentions remained stable. Among women who changed their fertility intentions in Burkina Faso and Kenya; however, income loss was associated with greater desires to delay or limit childbearing, particularly among the poorest women.

Across the six SSA geographies, about one in four women in each site expressed a shift in their fertility intentions; these shifts were generally in equal and opposite directions at the population level; however, resulting in limited change in overall fertility intentions (i.e., the proportions of women desiring to space or limit pregnancies were similar before and during the pandemic). Due to limited research on the stability of fertility intentions in SSA, and particularly longitudinal research with annual follow-up, we do not know if the shifts we observed in this study are different than levels of change that would have been observed prior to the pandemic. While most research on fertility in SSA has focused on fertility outcomes and behaviors, like births, pregnancy, and contraceptive use, there is a growing body of research highlighting the dynamic nature of fertility intentions. For example, research from Malawi, specifically the Tsogolo la Thanzi study, highlights the ways that women adapt their fertility intentions in response to changes occurring within their social and economic environments (Trinitapoli and Yeatman 2018; Sennott and Yeatman 2012); however, the adolescent population and more frequent follow-up of women in the study limits direct comparability. Variation in the level of stability in women's reported fertility intentions across different contexts likely reflects differences in sociocultural norms about pregnancy, childbearing, and the salience of motherhood in these geographies, in addition to external factors such as migration, education, and economic opportunities.

While we cannot state that overall levels of change differed from the prepandemic period, we find that approximately equal percentages of women adopted pronatal (wanting any/more children) and antinatal intentions (wanting no/no more children) during the pandemic, contrary to

the expectations of reproductive health researchers, programs, and advocates that COVID-19 would result in widespread and unmet desires to delay or limit future pregnancies,. While a greater proportion of women in each context expressed desires to slow, rather than accelerate, timing of their next birth, overall, we did not observe large shifts in time-based preferences for childbearing. These findings differ from evidence in high-income settings where greater shifts in childbearing desires have been observed (Luppi, Arpino, and Rosina 2020; Lindberg et al. 2020; Zhu et al. 2020; Malicka, Mynarska, and Świderska 2021) but align with earlier research in Kenya that found limited shifts in fertility intentions in the early stages of the COVID-19 pandemic (Zimmerman et al. 2022). Our study demonstrates the consistency in these findings across multiple SSA geographies and over a longer period, underscoring the importance of context in understanding the impacts of COVID-19—and similar public health emergencies—on population health and reproductive preferences. In settings where fertility remains highly valued, shocks introduced by COVID-19 may not lead to large changes in overall desired levels of fertility, both in terms of the number and timing of children, contrary to what has been observed in low-fertility settings.

Among women who changed their fertility intentions, however, we find some evidence that economic hardships experienced during the COVID-19 pandemic likely influenced these shifts. In Kenya, women with complete household income loss were significantly more likely to adopt antinatal intentions (wanting no/no more children) and women in wealthier households were less likely to decelerate their desired time to next birth (wanting children within the next year), relative to women in the poorest households. This indicates that economic challenges were associated with a desire to delay or limit childbearing, but that these shifts occurred primarily among women at the extremes (i.e., the poorest or those with complete income loss). Contrary to previous findings in Kenya (Zimmerman et al. 2022), we did not find a significant association between the experience of food insecurity with change in fertility intentions, nor any evidence that COVID-19 impacted the desire to have children sooner. This may be due to differences in measurement but also likely reflects that the influence of COVID-19 on food and economic security changed over time as lockdowns were lifted and acute shortages of food and increases in unemployment waned.

In Burkina Faso, the effect of income loss on childbearing intention was heterogeneous by prepandemic wealth category. Among women with complete household income loss, the odds of shifting toward delaying intended childbearing increased with wealth, while among women with partial income loss, the odds of delaying decreased with wealth. We find that the effect of income loss during the pandemic was moderated by women's preexisting household wealth, mitigating its impact on childbearing

decision-making among the wealthiest women but remaining strongly predictive among the poorest women. That poor women who experienced complete income loss were less likely to shift their intentions than women with partial income loss partially aligns with patterns seen in Malawi, where women who experienced food shortages were more likely to accelerate their preferred time to childbearing (Sennott and Yeatman 2012). We saw no relationship of economic shocks with accelerating fertility desires, nor any relationship with food insecurity, however. Research on the economic strategies of the poorest households in low-income countries has shown that poorer households that experience income shocks more frequently develop alternative financial strategies for dealing with income-related shocks (Collins et al. 2009) and that childbearing may be a positive response to income insecurity, as children are perceived as sources of future support and insurance against future economic shocks (Banerjee and Duflo 2012). Together, these could help explain why poorer households, including those in our study, are less likely to respond to economic shock by curtailing fertility desires. Additional research, including qualitative studies, would shed light on whether these or alternative theories explain how individuals have accommodated economic instability resulting from COVID-19 within their fertility intentions.

Beyond the influence of economic shocks, and despite considerable cultural differences across study settings, our findings further reinforce the important role of reproductive life course in shaping women's fertility intentions over time. In Burkina Faso and Kenya, women who had more than two children at baseline were consistently more likely to adopt antinatal intentions during the pandemic, expressing that they wanted no more children at follow-up, while also being less likely to adopt pronatal intentions during this time. We also found that women who experienced a pregnancy between surveys were more likely to shift to stating they wanted no more children, reflecting that they may have achieved their desired number of children. These findings suggest that intention-setting related to childbearing reflects transitions in the reproductive life course (i.e., a first birth, reaching reproductive goals), which may occur irrespective of shocks to economic, social, and health circumstances (Trinitapoli and Yeatman 2018; Mueller et al. 2019). Indeed, in sensitivity analyses exploring potential interactions between parity and economic shocks, we found no evidence that the impact of economic changes induced by COVID-19 (e.g., extreme food insecurity, income loss), affected women differently based on their stage of reproductive life course. Conversely, we also note that women in Kenya who experienced a pregnancy during the survey period, whether they were pregnant at baseline or after, were more likely to shift to having pronatal intentions (wanting any/more children). This relationship is similar to one observed by Iacovou and Tavares, wherein parents with recent births were less likely to adapt fertility expectations downwards

because they were less likely to have completed childbearing (Iacovou and Tavares 2011). Similarly, women who were pregnant during the survey period in Kenya may be less likely to have completed childbearing and, thus, more likely to change their intentions. That this relationship was present in Kenya and not Burkina Faso likely reflects the fact that, on average, women in Kenya have lower fertility ideals and thus were more likely to have already achieved their ideal family size.

Finally, our analyses direct attention toward the complexity of using time-based measures of fertility intentions to understand women's reproductive health needs and pregnancy preferences. We defined women as "stable" in their fertility intentions if they reported wanting a child within a consistent time period relative to baseline (e.g., a woman who wanted a/another child within two years at baseline and who wanted within one year at follow-up was considered "stable"). Research, however, has highlighted that many women do not form consistent time-based fertility intentions, and rather hold amorphous goals that are responsive to life events, such as relationship formation and dissolution (Ní Bhrolcháin, Beaujouan, and Berrington 2010; Zabin 1999; Yeatman, Sennott, and Culpepper 2013). In the absence of these events, women may still consider that they are consistent in their fertility intentions, even if they do not align with specific time points anchored within the context of a survey. Additionally, while we only explored changes in women's time-based intentions during this period, other dimensions of pregnancy preferences, such as ambivalence, ambiguity, acceptability, and emotional responses to an unexpected pregnancy, exist (Aiken et al. 2016). While we did not explore these facets of pregnancy preferences, it is reasonable to assume that people may maintain consistent time-based fertility intentions even while other dimensions of pregnancy preferences may change. This is especially salient in the context of COVID-19, in which women's emotional responses toward a pregnancy or sentiment of acceptability about a pregnancy may be particularly susceptible to fluctuate, even as overall intentions to have children within a certain stage of life may remain stable. Further research into whether COVID-19 affected these dimensions may shed additional light on how COVID-19 affects overall fertility behavior.

Results should be interpreted in light of limitations. First, the survey item measuring food insecurity during the pandemic reflects the most extreme form of constrained resources in the household by asking about lack of food for a whole day. This measure likely underestimates the levels of food insecurity introduced by the COVID-19 pandemic. As such, our findings that household food insecurity had a negligible impact on women's childbearing intentions likely mask underlying variability among families that experienced some food insecurity without experiencing the most extreme levels. Additionally, the question measuring income loss did not reflect the potential for income gains. We are limited to available data;

however, given the extent of economic loss experienced during COVID-19, it is likely that few households would have experienced income gains, and thus such households are likely adequately represented in the category of "no income loss." Similarly, we were not able to explore the role of other factors known to shape childbearing intentions, such as the recent death of family members, including children, and fears about future economic, health, and partnership stability which could be influenced by the ongoing pandemic (Trinitapoli and Yeatman 2018; Evens et al. 2015). Finally, given our approach to defining temporal changes in fertility intentions, orienting analysis in women's desired childbearing timing reported at baseline, the sample size of eligible women for analyses limited our investigation to women in Burkina Faso and Kenya only. While we were not powered to conduct regression analyses across all six geographies, we explored changes in women's reproductive intentions before and during the pandemic to describe overall trends occurring at the population level. Finally, our decision to define accelerators as those who switched to a desire to have a child within one year at follow-up may result in some misclassification as some women may consider the nine-month gestational period in their responses and thus report wanting to wait longer than one year, while still having accelerated their intentions, again underscoring the complexity of measuring stability in timing-based intentions.

Our study has a number of strengths including the use of population-based longitudinal data collected among women in six diverse SSA geographies throughout the first year of the COVID-19 pandemic to explore dynamics of fertility intentions during this time of considerable health, social, and economic uncertainty. In Burkina Faso and Kenya, we also leveraged longitudinal data collected just before the onset of the pandemic and one year later to understand changes to women's fertility intentions in the context of their unique social and economic circumstances. The use of longitudinal data supported the exploration of economic uncertainty with changes in fertility intentions and not cross-sectional associations with static fertility intentions measured concurrently with those changes.

Conclusion

Despite widespread income loss during the first year of the COVID-19 pandemic, we found relatively little change in fertility intentions across six geographies in SSA. In Burkina Faso and Kenya, we found heterogenous relationships indicating that, while economic factors were associated with shifts toward wanting to delay or limit childbearing, these effects were not uniform either within or across settings. These findings underscore the importance of accounting for context when anticipating the consequences of COVID-19 or other public health emergencies on fertility behavior.

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Data availability statement

All data underlying the development of this manuscript are publicly available at https://www.pmadata.org/data/available-datasets.

Conflict of interest

The authors have declared that no conflicts of interest exist.

Ethics approval statement

Ethical approval for PMA's data collection activities is provided by in-country ethical review boards, including the Ethics Committee for Health Research at the Ministry of Health and Ministry of Higher Education, Scientific Research and Innovation in Burkina Faso; the University Of Kinshasa School of Public Health in DRC; the Kenya Medical Research Institute (KEMRI) Ethics Review Committee in Kenya; and the Lagos State University Teaching Hospital Research Ethics Committee and the Kano State Health Research Ethics Committee of the Ministry of Health and the Research Ethics Committee of the Aminu Kano Teaching Hospital in Nigeria.

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